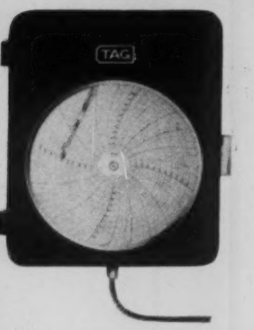
EB. 1947

20 No. 2

Instruments

E MAGAZINE *of* MEASUREMENT *and* CONTROL



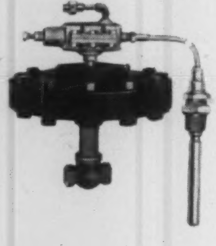
TAG Recording Thermometer: Long pen travel; 9, 10, 12 inch charts.

TAG Temperature Indicating Controller: Single system, accurate; rugged; direct-reading scale.

TAG Recorder Controller: Large, legible charts, mercury, vapor-tension or gas-filled actuation.

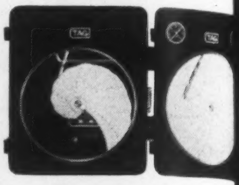
TAG Non-Indicating Controller: Small; accurate interchangeable tube systems.

TAG Self-Operated Controllers: Widely used in many different types of applications.

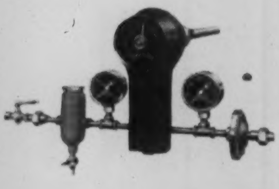


TAG Steam-Operated Controllers: Full throttling action; range 40° F., between 90° F. and 375° F.

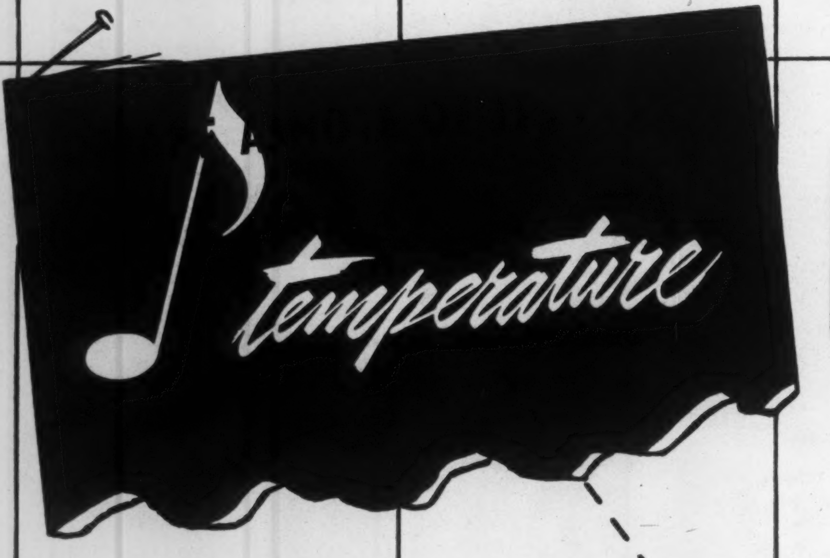
TAG Dial-Indicating Thermometers: Spiral armored tubing; union connection bulb; for vapor-tension ranges between —40°F. to 335° F.

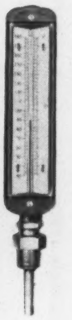


TAG Twin-Case Program Controller: Timing device teamed with Recorder-Controller. Time schedules quickly inter-changed.



TAG Faultless Non-Indicating Controller: Outstanding air-operated instrument of expansion stem type.





TAG Industrial Th
mometers: Straig
and side angle typ
Another of TAG
complete line
every industrial a
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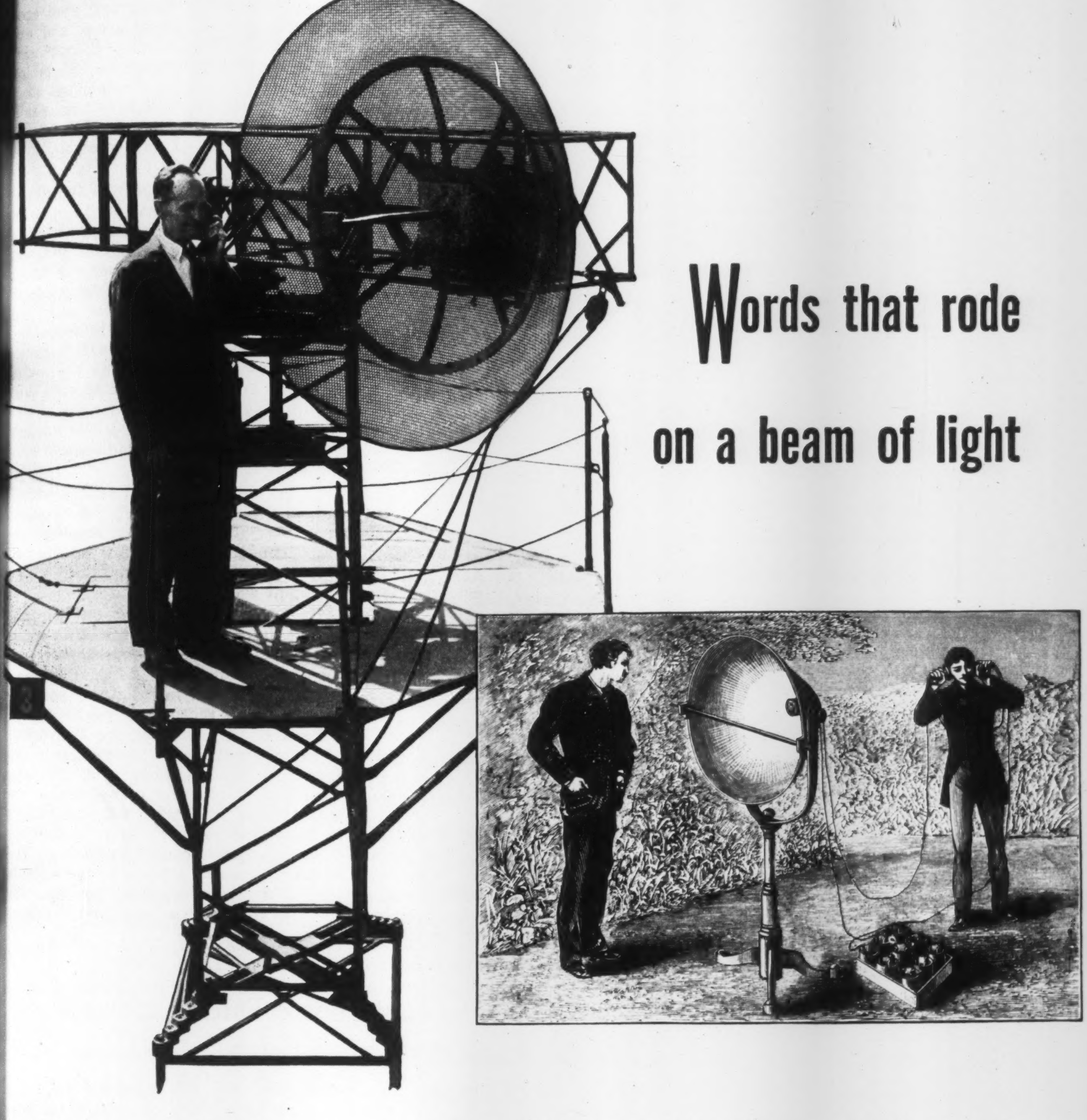
★ In countless industry-wide applications . . . wherever the question of measurement, recording or control of temperature arises . . . there's a TAG instrument to solve your problems. Sensitive yet durable, reliably accurate, TAG instruments are built to *stay* accurate! You strike the right note in plant economy, in uniform product quality when you specify "TAG".

ALWAYS SPECIFY... TAG

C. J. TAGliabue Division



Words that rode on a beam of light

If Alexander Graham Bell could look at the microwave antenna in the illustration, how quickly his mind would go back to his own experiments, 67 years ago!

For in 1880 the inventor of the telephone had another new idea. Speech could be carried by electric wires, as Bell had demonstrated to the world. Could it be carried also by a *light beam?*

He got together apparatus—a telephone transmitter, a parabolic reflector, a selenium cell connected to handphones—and "threw" a voice across several hundred yards by waves of visible light, electromagnetic waves of high frequency.

Bell's early experiment with the parabolic antenna and the use of light beams as carriers was for many years only a scientific novelty. His *idea* was far ahead of its time.

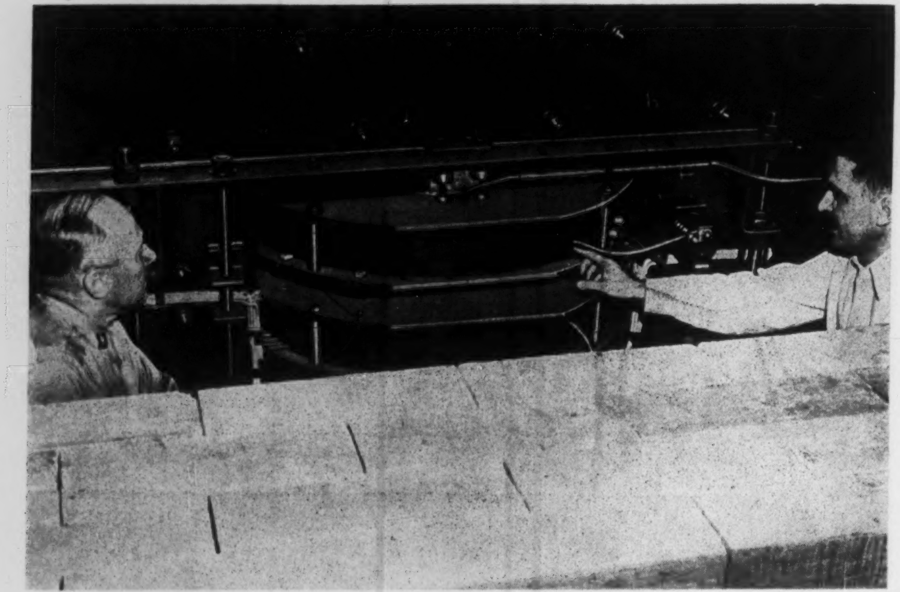
Sixty years later communication by means of a beam of radiation was achieved in a new form—beamed microwave radio. It was developed by Bell Telephone Laboratories for military communication and found important use in the European theater. In the Bell System it is giving service between places on the mainland and nearby islands and soon such beams will be put to work in the radio relay.

In retrospect, Bell's experiment illustrates once again the inquiring spirit of the Bell System.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

INSTRUMENTS ON THE MARCH



Three-day Forum Unveils Industrial Betatron

DOVER, N. J.—Picatinny Arsenal was host to more than sixty editors of newspapers and technical journals from all parts of the country who came to the Arsenal to view the first public demonstration of the 20,000,000-volt betatron manufactured by the Allis Chalmers Corp., whose rays can penetrate 20" of steel in 20 minutes to produce photos to detect flaws of almost microscopic dimensions.

During an Arsenal meeting, presided over by Prof. D. W. Kerst, University of Illinois physicist and inventor of the betatron, the editors heard a discussion of the various phases of the betatron's development, including an earlier installation at the Rock Island Arsenal and its application on some of the work in the Manhattan Project.

Col. W. E. Larned, Commanding Officer, opened the three-day forum. He explained how the betatron will enable the Arsenal to x-ray shells and rocket warheads up to several feet in thickness and weighing many tons on both a production-line and on an experimental basis. "By eliminating cavities in the explosive charge through radiographic inspection we can be sure that our large explosive shells will function exactly as planned, eliminating hazard to army personnel. The army became interested in the possibilities of using the betatron for x-ray work early in the war," reported Colonel Larned, "even though it was strictly a laboratory instrument at that time. Experience with the betatron gained at Picatinny and at the Rock Island Arsenal should be of great help to science and industry in the immediate future."

Col. C. R. Dutton, Chief, Technical Division, Dr. G. J. Mueller, Dr. B. A. Lloyd, and Miss Kathleen George, all from the Picatinny Physical Laboratories, acted as technical advisers during the first day's demonstration period.

Editors heard the betatron described as a dependable, fool-proof and economical tool for all industry and exhibited keen interest in the characteristics of betatron radiation which enables its rays to penetrate the thickest steel and which makes possible enlargements on radiograph film directly. [For technical description of the betatron, turn to page 162.—EDITOR.]

Dr. Kerst's own topic was the development of the betatron and its place in science. Electrons are accelerated in the instrument to "186,000 miles per second, just a fraction of a percent below the speed of light. This is the greatest velocity ever produced," he said, and explained the differences between the betatron and the earlier particle-accelerating instruments such as the cyclotron. He explained the betatron's possibilities as a laboratory source of cosmic rays and for studying the nucleus and to create artificial radioactive substances.

J. T. Wilson, Allis-Chalmers physicist, spoke on the use of the betatron in industrial radiography, emphasizing the optimal characteristics of the 20-Mev. rays and the advantages of the pin-point source.

D. T. Scag, consultant on betatron design associated with the University of Illinois and Allis-Chalmers, described the engineering details of the Picatinny Arsenal betatron installation, pointing out the safety features in particular.

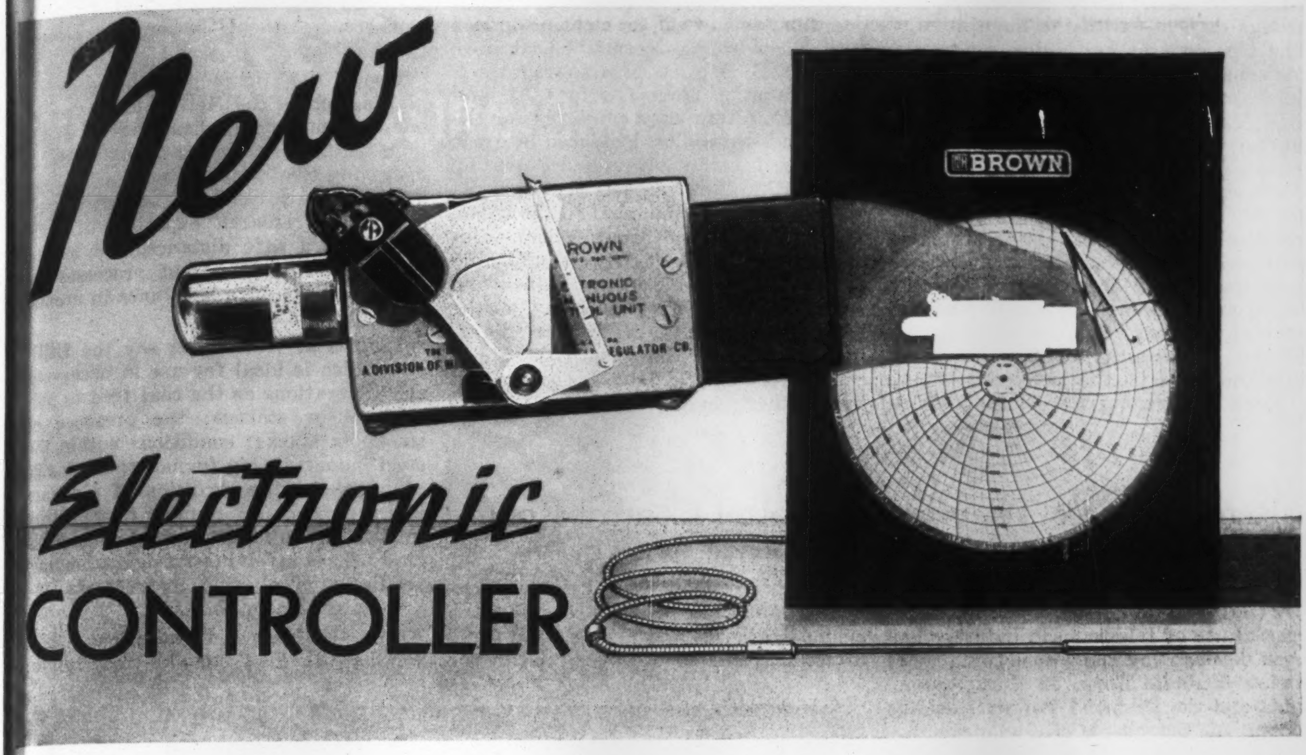
Prof. G. M. Almy of the University of Illinois spoke on "The Promise of the Betatron in Roentgen and Electron Therapy," reporting experiments on animals and explaining the possibilities in biological research and in treating diseases. The recent diversion of the 20-Mev. electron stream to the outside of the accelerating tube provides for the first time such a high-energy source of free electrons.

Movie Cameras Get Photos During 200-mile Trip Above Earth

CHICAGO—"Not in operating condition, but reasonably intact." Such was the U. S. Navy's official description of two Bell & Howell 16-mm. magazine-load motion picture cameras which recently soared 102 miles above the earth in the tail of a V-2 rocket. Having weathered the mile-a-second trip, the cameras also survived their 102-mile drop to the New Mexico desert, and brought down with them pictures made from a height of 40 miles.

Eight Bell & Howell cameras made the perilous ascent—and equally haz-

Official U.S. Navy photograph



FOR TEMPERATURES AND PRESSURES

This is the new Brown *Electr-o-Vane* Control Unit. To users f electric contact control Thermometers and Pressure Gauge Controllers, it offers a high degree of control performance never before ttained.

A true triumph in control, this electronic unit is not merely n adaptation of a known principle but an achievement in design y which all the shortcomings of similar devices are eliminated.

Added to the Brown Thermometer and Pressure Gauge line, the *lectr-o-Vane* Unit provides a control instrument of unequalled erformance. No instrument of this type can equal its dependability in service, its precision in operation or its safety features.

Brown *Electr-o-Vane* Thermometers and P Pressure Gauge Controllers are available *at no premium cost*. With all the exclusive features of these instruments, why compromise with less than the best.

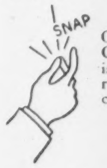
The *NEW* CATALOG fully describes the operating principle, eatures and models of the Brown *Electr-o-Vane* Controller. A opy will be sent to you without obligation. Write today for atalog 6001.

THE BROWN INSTRUMENT COMPANY, *a division of inneapolis-Honeywell Regulator Company,* 4482 Wayne Avenue, hiladelphia 44, Pa. Offices in principal U. S. cities and in Toronto, anada; London, England; Stockholm, Sweden; Amsterdam, olland.

HERE ARE THE FACTS

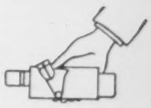
The Brown *Electr-o-Vane* Control unit operates on the principle that when a metal vane is interposed between two oscillator coils, the state of oscillation can be made to change or stop in an electronic circuit. This change or stopping of oscillation causes the electronic circuit to operate a load relay.

The oscillator coils are the heart of the controller. Brown oscillator coils are molded in bakelite and are thus *moisture-proof*—an exclusive Brown feature. A knife-edge control action is provided that does not drift. Control action is precise. It never varies. It is unaffected by moisture conditions.



Only the circuit used in the Brown *Electr-o-Vane* Control Unit causes an actual stop in oscillations. That is why this is the only instrument of its type providing real *snap action*—an important factor for precision control.

Brown *Electr-o-Vane* Control is contained in a neat, compact unit. It is self-contained, easily removed as a unit and unaffected by dust or dirt.



Electr-O-Vane

BROWN Electr-O-Vane

THERMOMETER CONTROLLERS

AND PRESSURE GAUGES

ardous descent—with the huge missile. The two cameras amidships, set to run for consecutive two-minute intervals at 16 frames per second, were not recovered. The remaining three pairs, timed similarly for consecutive operation, were mounted in the tail assembly of the rocket, and were set to operate at 16, 32, and 64 frames per second, respectively. Five of the latter six cameras were located subsequently where they had struck the earth with great force, and it was from these that the usable exposed film was removed. [Many *Instruments* readers no doubt saw the films in the newsreels.—Ed.]

Each camera carried 50 feet of 16-mm. film, two of the eight being loaded with Kodachrome. Normal lenses were used in all cases, with diaphragm settings ranging from $f/8$ to $f/16$, and yellow 2X filters were employed for the black-and-white film. Produced in great quantity for the Army and Navy by Bell & Howell during the war, cameras of this type were mounted in the wings of our aircraft and brought back valuable combat gunnery footage, affording positive records of enemy planes and surface craft destroyed. Many of the best sequences in the Navy film "Fighting Lady" were filmed with these gun cameras and could have been obtained by no other means.

Remote Gages Televised in Central Control Room of Huge Power Plant

FORT WAYNE, Ind.—The first successful use of television in industry has been disclosed by the Farnsworth Television & Radio Corp. of Fort Wayne, Ind., and the Diamond Power Specialty Corp., of Detroit, Mich., who collaborated in developing for commercial use a sight-transmitting system known as the Utiliscope, which has been in practical operation the past nine months at Consolidated Edison's giant Hell Gate Station power plant in New York City and will find obvious uses in atomic-power plants. Expected to play an important part in increasing efficiency and safety in industry, the Utiliscope shows, on a screen similar to that of a home television receiver, a picture of something currently taking place at a remote or inaccessible point. This televised picture is of the "200-line" classification. It is produced by 60 image fields a second, as compared with 48 in sound motion pictures. Moving and changing simultaneously with the operation it reproduces, the picture is continuous and there is no measurable time lag between its transmission and reception.

At Hell Gate Station, the Utiliscope is being used to show water levels in boiler drums remotely located from the main control room. A photoelectric camera focused on two water-level gages (see Fig. 1) continuously transmits the picture to the associated control panel where the image is reproduced on a screen (see Fig. 2). This permits observers in the control room to keep a constant check on the boiler 325 feet away. Not only are the boiler and main control room separated by a distance greater than an average city block, but also by eight floors, a building wall and various other obstructions.

Gages on large boilers such as the one at Hell Gate must be under direct visual surveillance at all times because expensive damage can be caused if water in the boilers rises too high or drops too low. Lofty heights of the boiler drums and line-of-sight obstructions such as galleries and piping often make direct surveillance of gages difficult for workers, but the Utiliscope has solved this problem.

Use of the Utiliscope in large power plants such as the Hell Gate Station is one of numerous applications for which it is suitable in increasing industrial operating efficiency and safety. It is expected to be valuable in the conduct of dangerous research experiments visually from a safe distance, and in the observation of dangerous processes involving radioactive substance in atomic power plants.

Industrial technicians say the Utiliscope also is ideal for use in observing such operations as the coal feed to pulverizers or stokers; the presence of smoke in stacks; conditions within the steel industry's big furnaces; the inside of oil wells; the condition of pipelines and their pressure pumps; temperature indicators in large warehouses, especially those involving refrigeration, and readings on electric instruments and meters at remote points.

The Utiliscope installation, which weighs 121 lbs., includes four units:

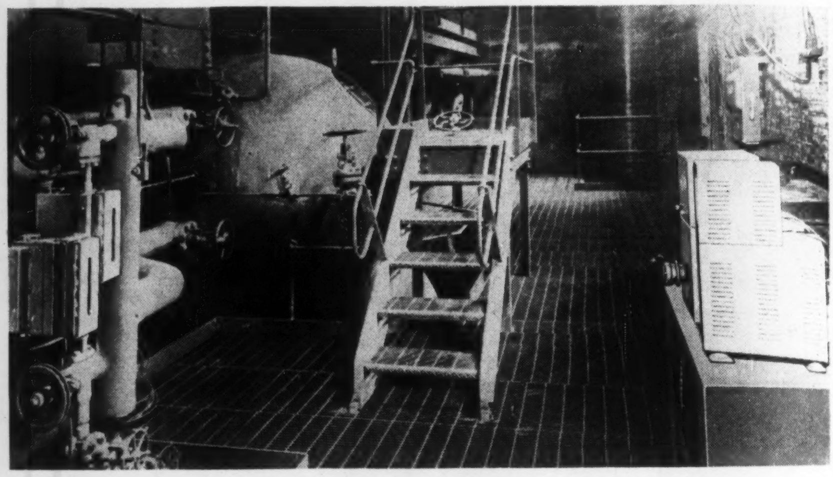


Fig. 1. Photoelectric camera (right) picks up image of water-level gages (left) and transmits image to control room (Fig. 2) 325 feet away. Transmission is by wire, not by radio.

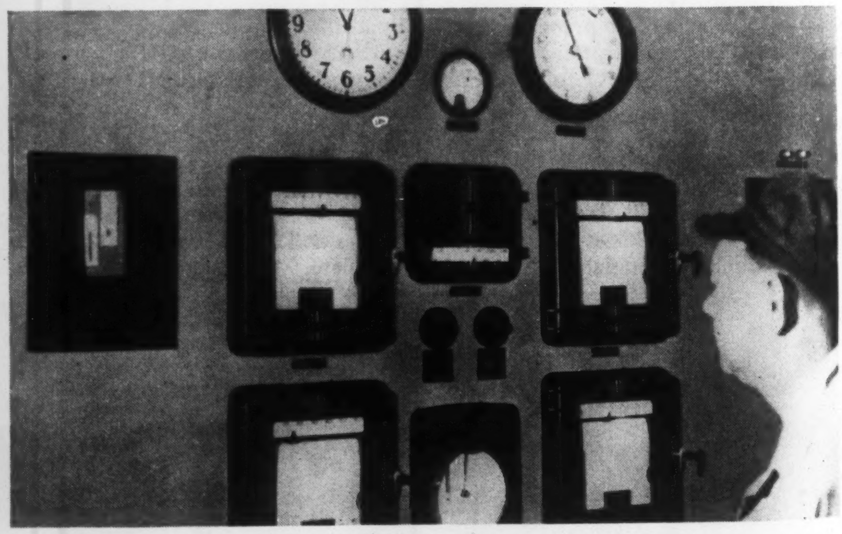
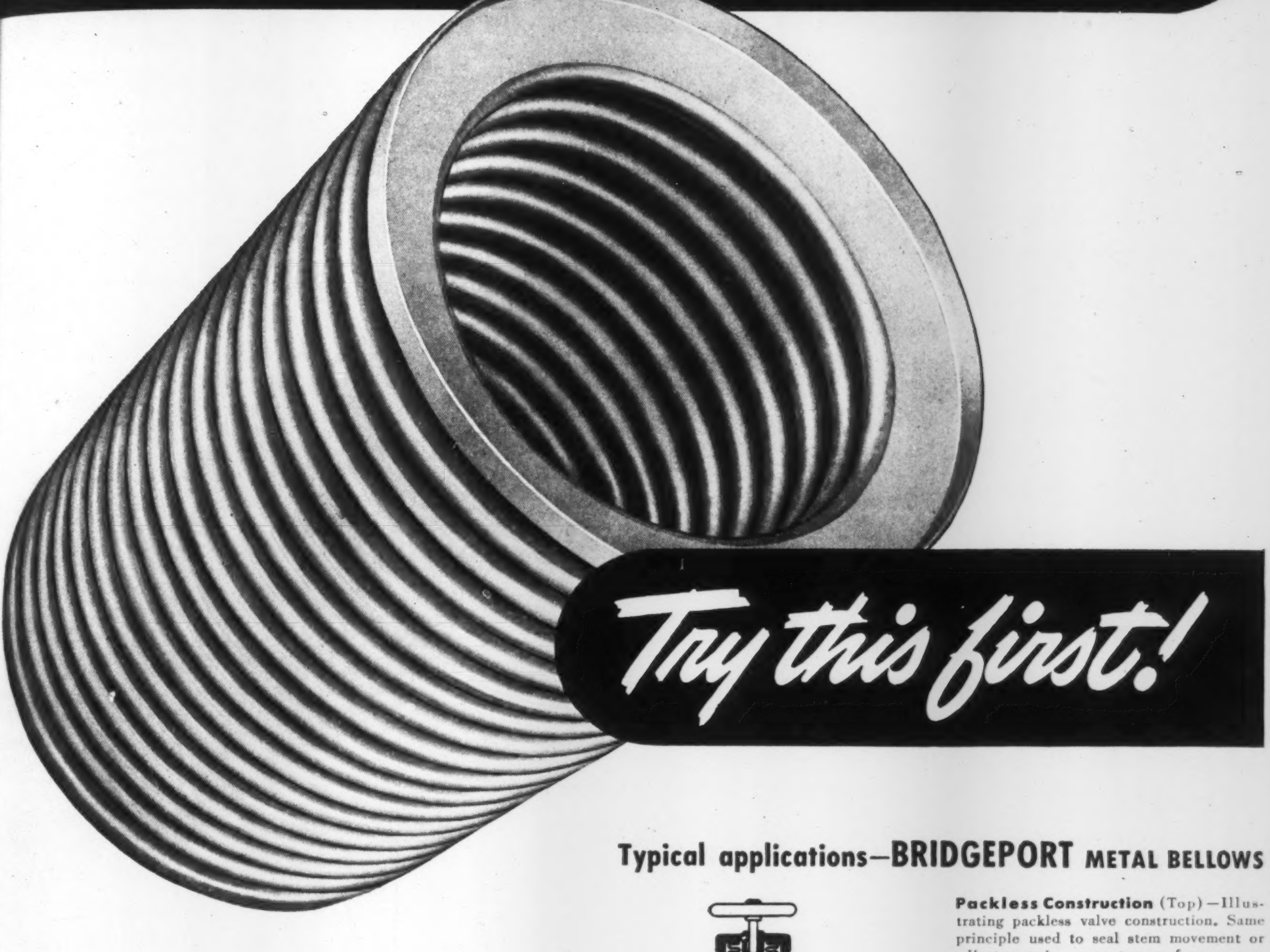


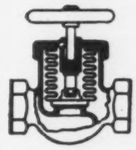
Fig. 2. Operator in central control room observes image of water-level gages on television receiver screen (left) as he would see these gages if he were stationed at the boiler 325 ft. away.

to make pressure and temperature behave...

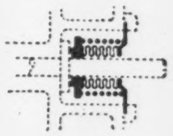

Try this first!

If you are planning a product involving pressure or temperature controls, check with Bridgeport engineers first. They've helped many manufacturers, in all industries, solve such problems—with Bridgeport metal bellows, bellows assemblies and devices. Bridgeport metal bellows are designed and produced on order to meet your requirements exactly—are available in a wide range of metals and sizes, from $\frac{15}{32}$″ to 12″ O. D. Bridgeport engineers welcome an opportunity to work with you, on *your* particular needs. Write today—ask for Catalog CE-100 that gives you complete information.

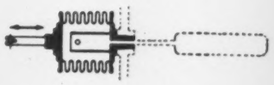
Typical applications—BRIDGEPORT METAL BELLOWS



Packless Construction (Top)—Illustrating packless valve construction. Same principle used to seal stem movement or adjustment in many types of apparatus.



Shaft Seal (Center)—Used for refrigeration compressors, etc., to prevent leakage around revolving shaft. Spring pressure holds nose of seal against shoulder on shaft. Another type used rotates with shaft and seals against stationary plate.



Thermostatic Motor (Below)—Widely used in temperature regulators, etc. Thermostatic charge confined in bellows. Used to operate a valve, switch, damper, etc., in response to temperature changes. Available with or without remote bulb. Without thermostatic charge and bulb, serves as Pressure Motor.

Bellows Assemblies . . . Bellows . . . Bellows Devices

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PHOTO ELECTRIC CELLS

Unmounted Cells

The shapes of Luxtron photocells vary from circles to squares, with every in-between shape desired. Their sizes range from very small to the largest required.

In addition to the unmounted cells shown here, Bradley also offers cells in a variety of standard mountings, including plug-in and pigtail types.

For direct conversion of light into electric energy, specify Bradley's photocells. They are rugged, lightweight and true-to-rating.

Illustrated literature, available on request, shows more models of Bradley photocells, plus a line of copper oxide and selenium rectifiers. Write for "The Bradley Line."

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camera with deflection unit, two small power units and the monitor or viewer. It has fewer tubes than a good radio set. No radio transmission is used: a four-lead cable connects the pick-up and receiver stations. [EDITOR'S NOTE.—See technical description in New Instruments Dep't, page 160.]

Corrosion-research Balance Weighs Single Layer of Atoms

EAST PITTSBURGH, Penna. — To find out how oxygen combines with metals, and how fast, Dr. Earl A. Gulbransen of the Westinghouse Research Laboratories is weighing oxide films ("rust") with a tiny weighing instrument so sensitive that it measures its loads in weight units of ten billionths of an ounce. Each year rust, tarnish and corrosion cause an estimated 200 millions dollars' damage to bridges, steel buildings and machine parts. Through this research, Dr. Gulbransen is seeking new ways to protect steel and other metals against the destructive action of oxygen in the air.

The special balance devised for this study is sealed in a glass tube to take measurements on metal pieces about half the size of a razor blade. Movements of the balance's pointer, observed through a microscope, reveal the weight added to a tiny sample of steel by a single layer of oxygen atoms. One layer of atoms is about ten billionths of an inch thick. There are enough atoms in a thimbleful of gaseous oxygen at room temperature and atmospheric pressure to form more than 65,000 such layers on the steel sample.

The balance, about 6″ long and 1″ square, is enclosed in one arm of a glass tube the shape of a cross, three feet tall and two feet wide, of which only a part is seen in Figs. 1 and 2. The moving arm of the balance is a piece of quartz 6″ long and 1/16″ in diameter. It is supported in the middle like a see-saw by a fine piece of tungsten wire, stretched across a quartz framework. See Fig. 2. Quartz is used because of its negligible temperature coefficient of expansion.

From one end of the moving beam the steel sample is suspended on a two-foot piece of tungsten wire inside the vertical part of the glass tube. A counterweight, with the same weight as the sample, is hung on the other end of the beam.

The sample is polished and washed three times in alcohol before it is placed in the tube, but the brief contact with air is enough to form several layers of oxide. The tube is sealed and the air is removed by two vacuum pumps. Final cleaning is done with hydrogen. A small amount of the gas is piped into the tube from a pressure tank. The hydrogen combines with the oxygen on the sur-

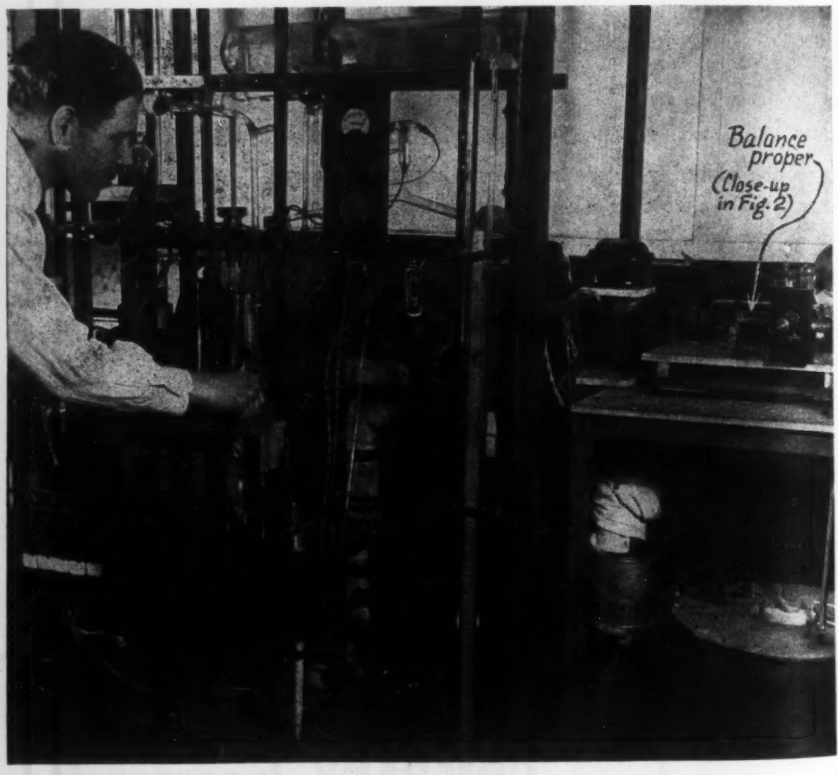
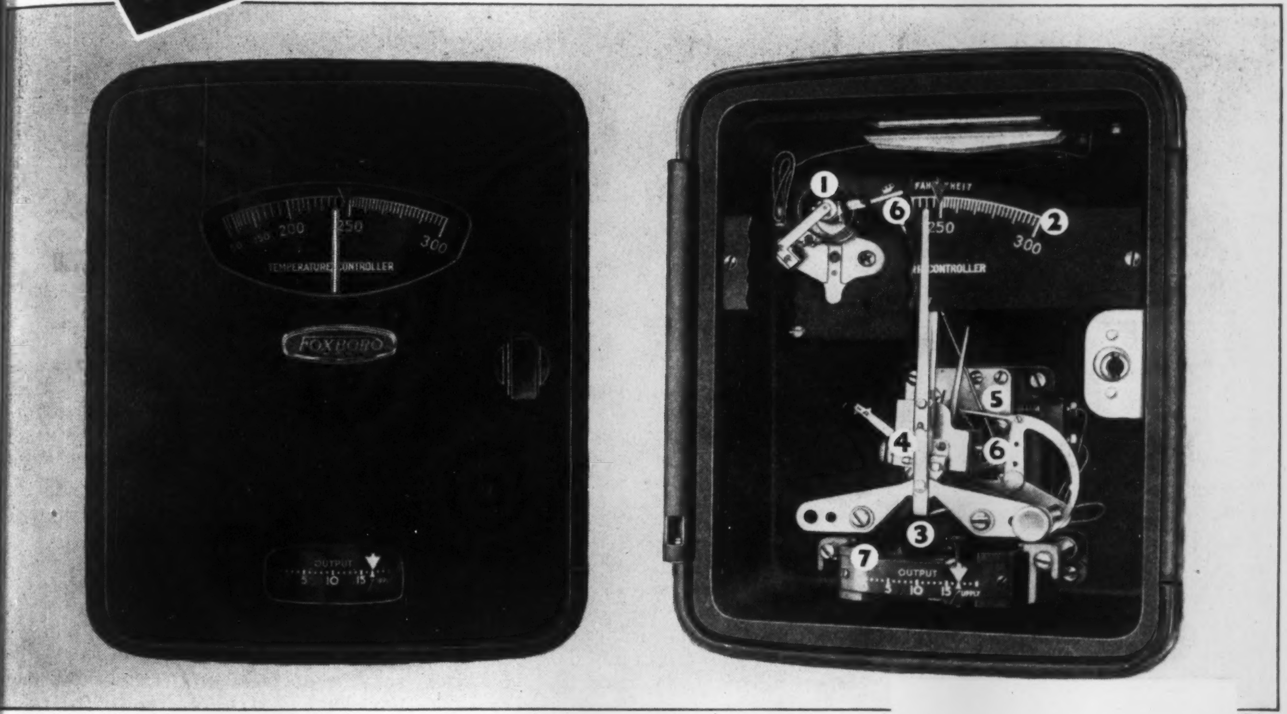


Fig. 1. Rust and tarnish are measured in units of ten billionths of an ounce by Dr. Earl A. Gulbransen by means of the instrument on the table at the right.

The NEW FOXBORO M-41 CONTROLLER

Purposely designed for Simple Processes

- ✓ HIGH ACCURACY
- ✓ LOW MAINTENANCE
- ✓ LOW FIRST COST



- **1** Standard Foxboro Measuring Element
- **2** 4″ Scale
- **3** Sturdy, simple easy-to-remove control unit
- **4** Proportioning Mechanism that moves on single center of motion as control setting knob is changed.
- Control Relay . . . same as M-40
- **6** Exclusive Foxboro Ball Linkage
- **7** Exclusive Foxboro Dual Pressure Gauge

Rotax (electric) Controllers in matching cases also available.

NOW . . . automatic control of simple processes can be economically justified with the introduction of this new Foxboro M-41 Controller. It has been designed from start to finish for the control of simple processes that do not involve complex process lags.

On simple processes, the majority of which call for on-off control, performance depends primarily on the precision of the on-off control action. The Foxboro Model 41 Controller has been designed to give the most precise on-off action possible. For certain purposes, however, it may be conveniently adapted on-the-job to give proportioning action between ¼% and 10% of scale.

The engineering design and quality of construction of the M-41 Controller are on a par with other famous Foxboro Instruments . . . some of its parts are interchangeable with them. All parts are engineered with typical Foxboro care.

Wherever you have simple processes that involve the control of temperature, pressure, liquid level or relative humidity, consider this new Foxboro Economy Controller. It offers, through automatic control, the advantages of greater uniformity of product and higher plant efficiency with lower cost. Write for Bulletin 388 for complete details. The Foxboro Company, 46 Neponset Ave., Foxboro, Mass., U. S. A.

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pH METER

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- Accurate to 0.1 pH.
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- Self contained in one metal case including electrodes, KCl and buffer solutions.
- Extreme stability makes standardization necessary only occasionally.
- Completely automatic temperature compensation.

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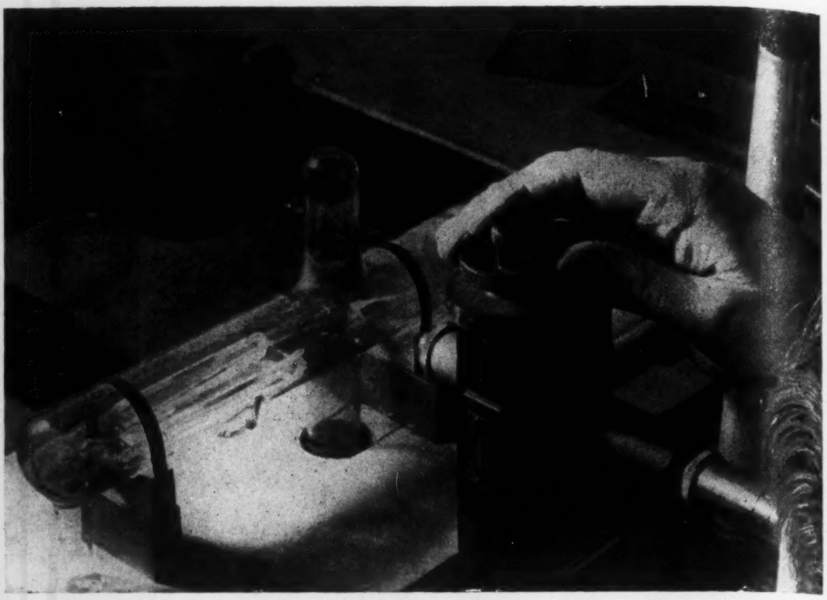


Fig. 2. With a microscope, Dr. Gulbransen reads the weight of oxygen atoms that tarnish steel and other metals. The white glass weighing instrument inside the tube, left, measures in weight units of ten billionths of an ounce a single layer of atoms on a piece of steel half the size of a razor blade. The see-saw weighing beam is suspended on an invisible strand of tungsten wire. Below the table, inside the vertical part of the tube, the metal sample is hung by fine wire from the right end of the beam.

face of the sample to form free water vapor, which is then pumped out of the tube.

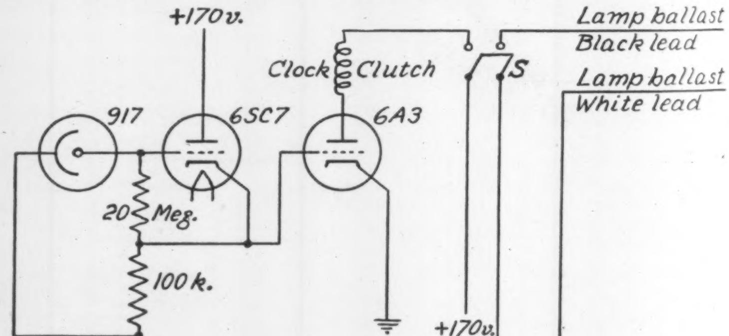
To start the experiment, a small amount of oxygen is admitted to the tube from another tank. The sample gets heavier as the oxygen combines with the surface layers of the steel, swiftly at first and then slowly. Movement of the balance beam is watched through the microscope, and the changes in weight are recorded.

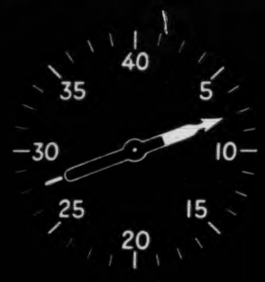
Phototube Relay for Time Lag Measurement

SALEM, Mass.—The basic circuit diagram of a phototube relay designed to measure time intervals with synchronous stop clocks and using the wide spectral range characteristics of type 917 phototube has been disclosed by Trevor Temple, Engineer, Sylvania Electric Products Inc. It is shown in Fig. 1. This relay will provide satisfactory measurement of fluorescent-lamp starting lag for all commercial fluorescent lamp sizes as well as for standard germicidal lamps.

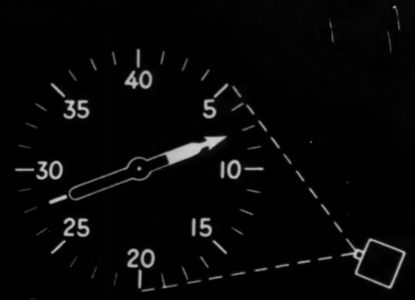
Input voltage is adjusted to suit requirements of lamp under test before the double-pole switch is closed. Closing the switch energizes the clock clutch coil and the lamp ballast. When the test lamp is not lighted, no current will flow from the 917 phototube through the grid resistor of the 6SC7 cathode follower. Consequently, the cathode follower draws a maximum of plate current, and the 6A3 triode is thus made positive. Low plate-to-cathode resistance of the 6A3 permits operation of the clock clutch.

When the test lamp is lighted, current through the 917 phototube causes the grid of the 6SC7 to become negative, thus reducing plate current. Since the 100,000-ohm cathode resistor connected

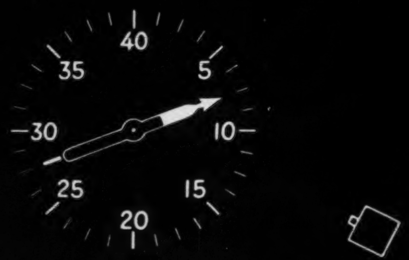




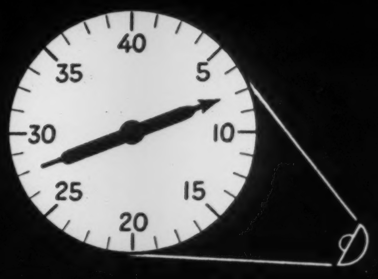
Self-Luminous — Radioactive markings and pointers shine brightly in darkness, are clearly readable without use of any outside light source.



Fluorescent — Fluorescent markings and pointers shine brightly under ultraviolet radiation. Brightness is controllable.



Phosphorescent — Phosphorescent markings and pointers have a useful afterglow following activation by ultraviolet or visible light.



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Which type of dial best meets your need?

Whether your primary interest is accuracy, handsome appearance, low cost, or clear readability in daylight, artificial light, or darkness — or a combination of any or all of these characteristics — the United States Radium Corporation is prepared to meet your dial requirements exactly.

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- **POWDERS:** *cathode-ray tube and television tube*
- **SILHOUETTE ILLUMINATION** *of clocks, watches and instruments*

US RADIUM

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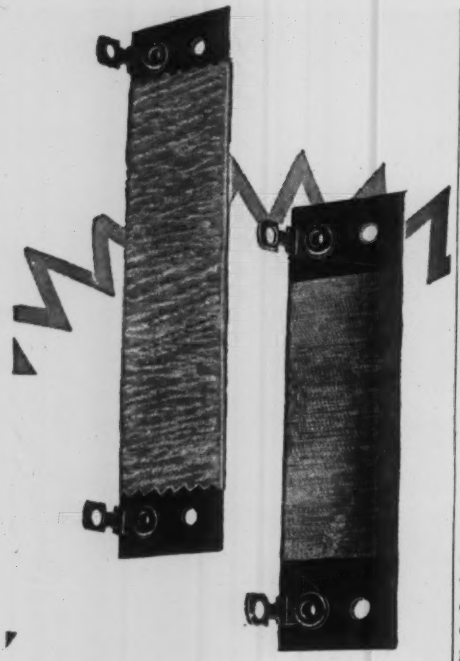

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★ Just turn those tight-tolerance resistor requirements of yours over to CLAROSTAT, just as other instrument-makers have been doing for years past.

Remember, CLAROSTAT specialists offer over two decades of winding experience, outstanding skill, and exclusive winding facilities. They wind all wire sizes even down to .0009" dia. Windings as fine as 600 to 700 turns per inch, on bakelite, ceramic or other material, flat or round. Also string windings in fibre glass and cord.

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Solving your resistance and control problems is our business. Call on us for engineering collaboration, specifications, quotations.

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to minus 170 volts with respect to ground will then have less voltage drop, the 6SC7 cathode will also become negative with respect to the ground. The grid of the 6A3 connected to this cathode will be cut off and the clock clutch will drop out.

Operating current of the clock clutch coil, ranging from 40 to 50 milliamperes, is easily handled by the 6A3 tube. Cathode follower application of the 6SC7 permits the use of high series resistance in the phototube circuit for high sensitivity and convenient cable length between the phototube and the 6A3.

The phototube selected should be sensitive to radiation characteristic of lamp being tested. The cathode follower may be any high-mu low-plate-current triode. The output tube should be capable of supplying relatively large plate current at nominal plate voltages. A large input resistor to the cathode follower may be used, particularly if available radiation is small. The value of the cathode resistor is not critical, but it should not exceed 0.5 megohm. Adjustment of clock clutches may be required because, as they are supplied, there is a wide range in the values of pull-in current.

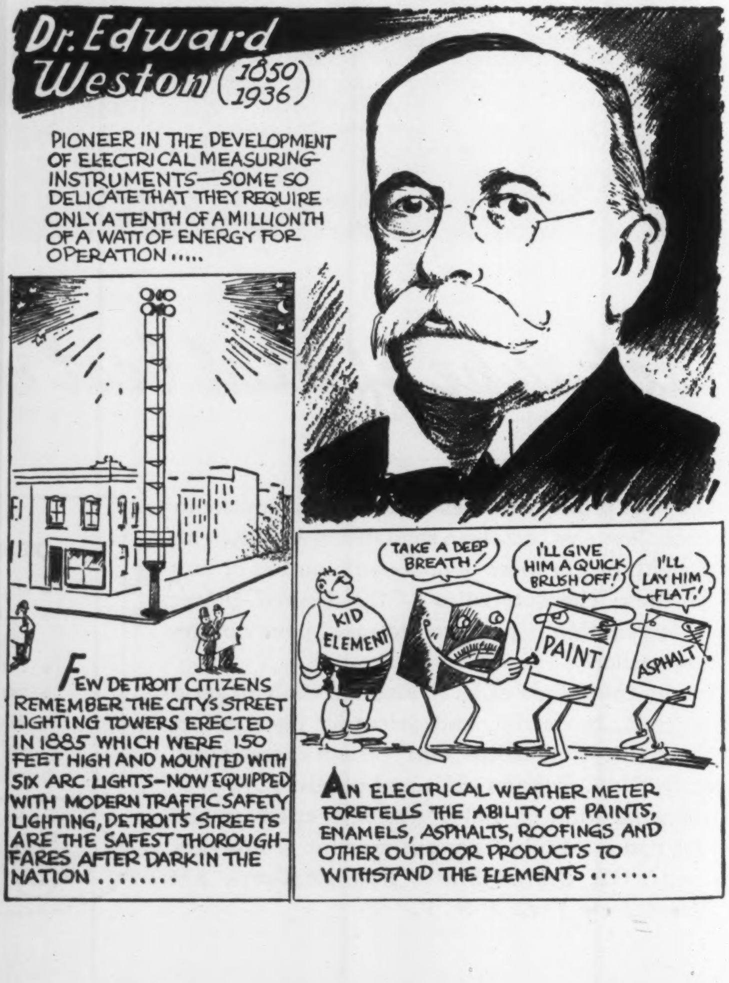
Rapidly-tunable High-precision Narrow-band Color Filter

CAMBRIDGE, Mass. — An electrically charged camera filter that lets through any single desired wave-length of light and excludes the thousands of other narrow wave-lengths which together produce the sun's white light, was described here by its inventor, Dr. Bruce Billings, Polaroid Corp. research physicist. The new filter promises to give scientists an opportunity to chart solar prominences in greater detail, thus improving long-range weather forecasting and radio reception which are seriously affected by the radiations and static-producting particles coming from these solar streamers.

High-precision polarizing filters with fixed passbands have been built in the past for photographing solar prominences. The important new feature of the Billings filter is its ability to change transmission from any one wave-length at the turn of a dial, with out loss of precision or optical quality. Transmission changes can be made in less than one hundred-thousandth of a

Facts File . . .

Courtesy Electrical Manufacturers Public Information Center


Dr. Edward Weston (1850 1936)
PIONEER IN THE DEVELOPMENT OF ELECTRICAL MEASURING INSTRUMENTS—SOME SO DELICATE THAT THEY REQUIRE ONLY A TENTH OF A MILLIONTH OF A WATT OF ENERGY FOR OPERATION .....
FEW DETROIT CITIZENS REMEMBER THE CITY'S STREET LIGHTING TOWERS ERECTED IN 1885 WHICH WERE 150 FEET HIGH AND MOUNTED WITH SIX ARC LIGHTS—NOW EQUIPPED WITH MODERN TRAFFIC SAFETY LIGHTING, DETROIT'S STREETS ARE THE SAFEST THOROUGHFARES AFTER DARK IN THE NATION ....
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I'LL GIVE HIM A QUICK BRUSH OFF!
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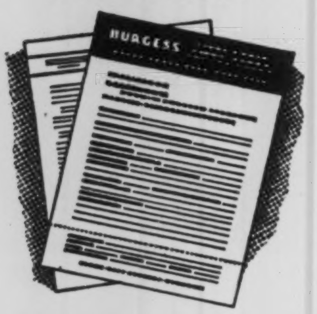

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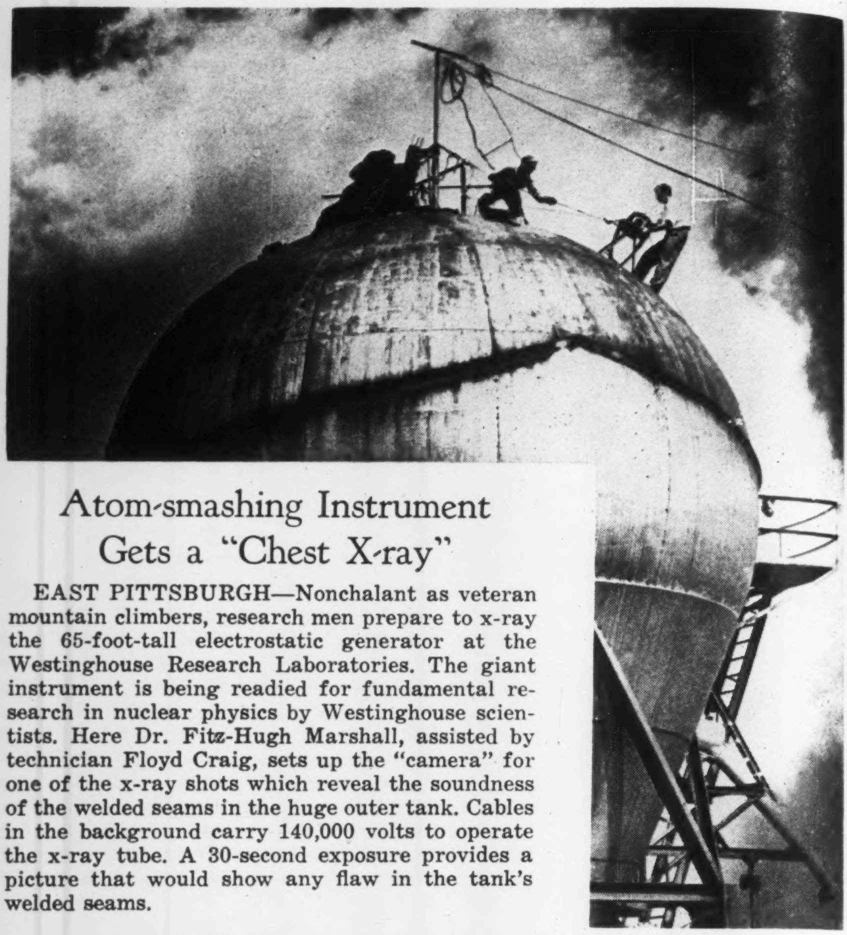


Atom-smashing Instrument Gets a "Chest X-ray"

EAST PITTSBURGH—Nonchalant as veteran mountain climbers, research men prepare to x-ray the 65-foot-tall electrostatic generator at the Westinghouse Research Laboratories. The giant instrument is being readied for fundamental research in nuclear physics by Westinghouse scientists. Here Dr. Fitz-Hugh Marshall, assisted by technician Floyd Craig, sets up the "camera" for one of the x-ray shots which reveal the soundness of the welded seams in the huge outer tank. Cables in the background carry 140,000 volts to operate the x-ray tube. A 30-second exposure provides a picture that would show any flaw in the tank's welded seams.

---

second. This tuning is made possible by the use of crystal plates which change their optical characteristics under the influence of electrical charges.

The flaming solar streamers can be photographed only because their light is concentrated in a few wave-lengths. Although the light from the dense body of the sun is many times more brilliant, it is divided among thousands of wavelengths. When the Billings filter is aimed at the sun through a coronagraph (which produces an artificial eclipse) and tuned to let through the light from the solar streamers, it blocks substantially all the scattered light from the sun's disk. The streamers then photograph against a dark background.

Electrode Function (pH Response) of Potash-Silica Glasses

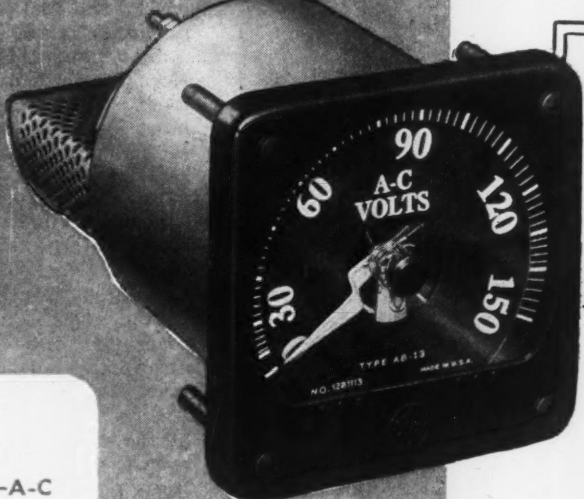
WASHINGTON, D. C.—A study of the electrode function (pH response) of a limited series of potash-silica glasses indicates voltage departures from the theoretical, at pH values greater than 4.0, of such magnitude as to render them unsuitable for glass electrodes, according to a report in the October *Journal of Research* of the National Bureau of Standards (RP1743). Furthermore, results of the investigation support the theory that glasses of high hygroscopicity (water sorption) will have sensitive pH responses, and that changes in the durability of a glass will be accompanied by voltage departures for an electrode prepared from such a glass.

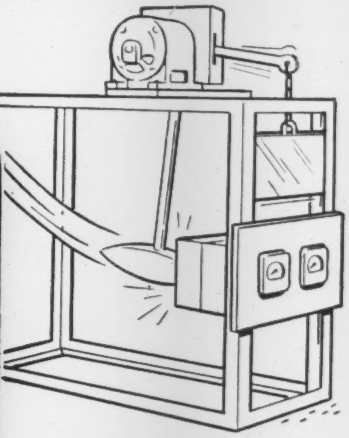
These two properties, namely, hygroscopicity and chemical durability in solutions of a wide range of pH values, appear to determine largely the suitability of a glass for measuring the hydrogen-ion activity of aqueous solutions, in accord with the simplified Nernst equation, $E=0.000198T$ pH. This equation yields a theoretical value of 59 millivolts per pH at 25°C.

Five potash-silica (K_2O-SiO_2) glasses were used in this investigation by Donald Hubbard, which included determinations of hygroscopicity, pH response, and chemical durability. These glasses had been carefully prepared in the Bureau's Glass Section for studying their physical properties. Their composition varied from 71.83 to 83.07 percent of SiO_2.

The glass electrodes were blown as thin-walled tubes on the end of tubing made from the experimental glasses, and the inner electrical connection was

it's a TOUGH instrument





This is the test to which the high-shock form of concentric-scale instruments is subjected. A 2000 ft-lb impact does *no mechanical damage*—and the instruments *continue to operate,* although the original 1 percent calibration is not retained.

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- DB-13—D-C
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- AMMETERS A-C & D-C
- WATTMETERS
- VARMETERS
- POWER-FACTOR METERS
- SYNCHROSCOPES
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- Temperature Meters
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Having successfully developed instruments that could take the tremendous impacts associated with warships in combat, General Electric has used this engineering knowledge to build greater sturdiness, increased reliability, and better long-time accuracy into every concentric-scale switchboard instrument.

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Unusual readability, accuracy to within 1 per cent, extreme compactness, and greater sturdiness are all combined with other high-quality features to provide a general-purpose instrument of advanced design.

Take advantage of this progress and experience in combating shock by specifying G-E concentric-scale switchboard instruments for all future installations. More detailed information can be found in Bulletin GEA-3432. Ask your nearest G-E sales office for a copy. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

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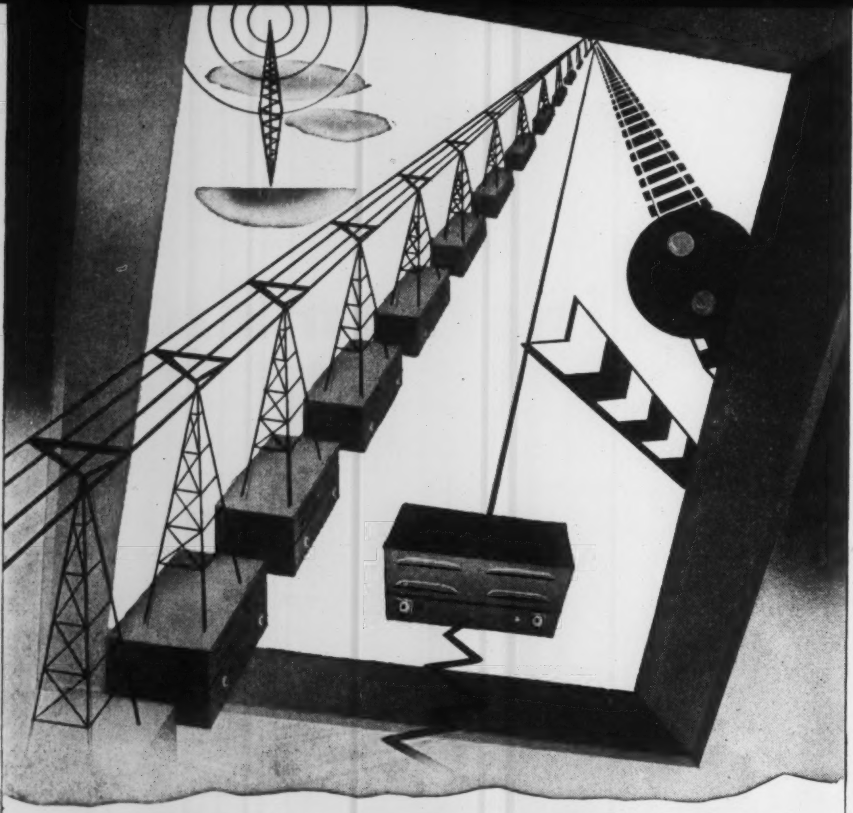

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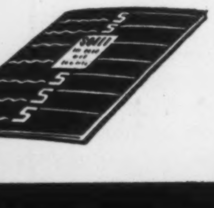

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obtained by filling the bulb with mercury. Chemical durability measurements were made by the interferometer method, on a single specimen of glass that was reground and repolished after each test. In order to have results comparable with work previously reported in other publications, the Britton-Robinson universal buffer solutions were used.

All the glasses investigated showed a very high hygroscopicity, with an accompanying sensitive pH response. However, between pH 2 and 4, glasses of 71.8 and 73.6 percent SiO_2 gave pH-response values higher than the 59 millivolts per pH predicted from the Nernst equation. Electrodes prepared from all of the specimens demonstrated large voltage departures from the straight line relation with increasing alkalinity of the buffer solutions.

For a glass of 75.76 percent SiO_2 content, the voltage departures were compared with the sodium-ion concentration, (Na^+), of the buffer solution, as well as with the chemical durability of the glass. The voltage departures correlated with the magnitude of the attack more convincingly than with pNa.

Although their hygroscopicity is high, giving them a very sensitive pH-response, the durability characteristics of these potash-silica glasses are so poor that voltage departures appear at pH values greater than 4.0, even for the best glass examined.

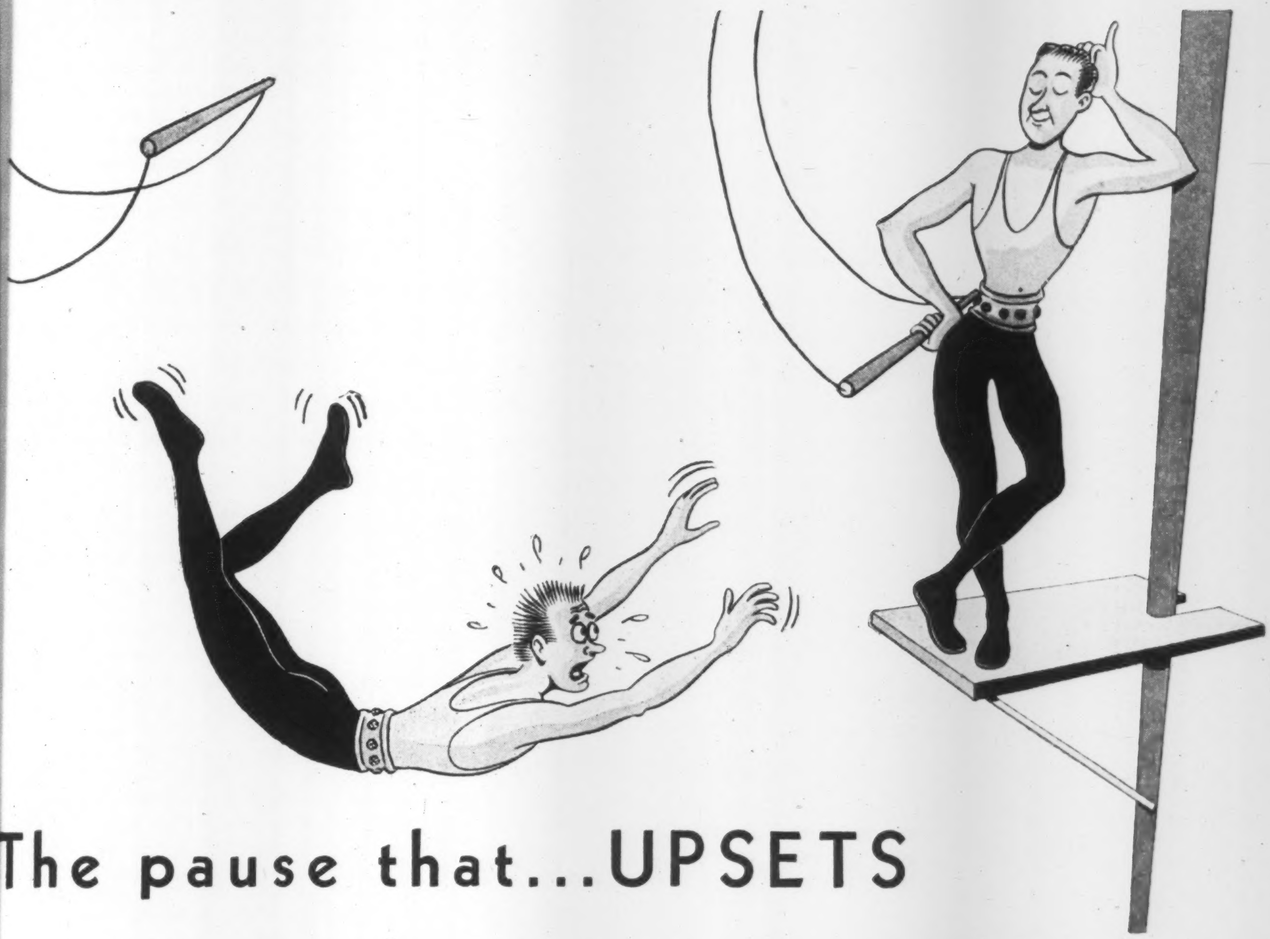
International Committee on Weights and Measures

WASHINGTON, D. C. — The National Bureau of Standards reports that the International Committee on Weights and Measures met in Sèvres and Paris October 22 to 29, 1946, for its first official session since 1937. Out of 15 members, eleven took part in the session. These were Louis de Broglie of France; G. Cassinis, Italy; M. Chatelain, U.S.S.R.; E. C. Crittenden, Associate Director of the National Bureau of Standards, U.S.A.; M. Dehalu, Belgium; W. J. deHaas, Netherlands; E. S. Johansen, Denmark; W. Kösters, Germany; Z. Rauszer, Poland; M. Ròs, Switzerland; J. E. Sears, Great Britain; and in addition Albert Pérard, Director of the International Bureau of Weights and Measures. Members from Roumania, Sweden and Yugoslavia, who had expected to attend, were unable to get to Paris. From the Japanese member, Professor H. Nagaoka, no news has been received since 1939. Mr. Sears was elected President of the Committee until next session in 1948, and Mr. Dehalu permanent Secretary.

Technical problems considered by the Committee included:

the practicability of adopting the wave-length of some spectral line as the primary standard of length;

the definition of units of heat; and



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can occur in your processes too.

The surest way to avoid trouble is never to let things get out of hand.

This is the basis of the "Continuous Balance" concept in measurement and *control* of industrial processes. Instantaneous detection and *correction* of the slightest change prevents any appreciable change from occurring. Secondary reactions never have a chance. Process upsets never occur.

The important fact is that "Continuous Balance" *measurement and control* is simultaneous with temperature changes. This is why intermittent or "nudging" controllers cannot handle today's process control requirements.

In the Brown ElectroniK Potentiometer which is the only instrument operating on the "Continuous Balance" principle, there are no intervals. There are no pauses. Just smooth instantaneous regulation of process conditions.

The Brown ElectroniK Potentiometer with the well-known Air-o-Line control unit provides everything that is desired in process control.

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FROM 150,000 OHMS THIS SIZE . . .
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WIRE WOUND
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. . . TO 20 MEGOHMS THIS SIZE (hermetically sealed)
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Shallcross Akra-Ohm Resistor types are designed to meet Joint Army-Navy Specification JAN-R-93.

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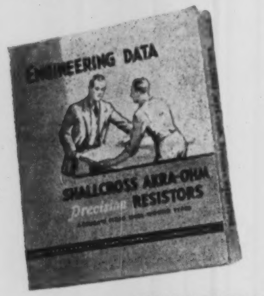

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The user of Shallcross Akra-Ohm Precision Resistors has an assortment of 54 standard types from which to choose. You can get the exact needed resistance value, size and mounting style — *from standard stock items.* Also, Shallcross facilities for precision resistor production are such that special adaptations can be made on short notice at moderate cost. All types have special humidity protection.

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Bulletin — 810
- Standards — Resistance and Decade Boxes

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- Rotary Selector Switches

Bulletin — G Includes:
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Potentiometers — step and slide-wire
FM and Television Sound Components

the revision of the International Temperature Scale.

Definite decisions were made to proceed with the adjustments of the units of electricity and of light which had been planned for 1940, and to introduce the new units into practice as of January 1, 1948.

The electrical units designated as "international" are to be replaced by "absolute" units derived directly from the basic mechanical units and consistent with them within the errors of measurement. The "international" units used in various countries are slightly different and, as a basis for comparisons, mean international units were set up at the International Bureau before the war by taking the means of the units maintained by the national laboratories of France, Germany, Great Britain, Japan, U.S.S.R., and the United States. The relations accepted by the International Committee for transferring from one system of units to the other are as follows:

1 mean int'l ohm = 1.00049 abs. ohms
1 mean int'l volt = 1.00034 abs. volts

The units of light to be introduced are the "new candle" and "new lumen" the magnitudes of which are fixed by taking the brightness of a black-body radiator at the temperature of solidification of platinum as 60 candles per square centimeter. For light differing in color from that given by this primary standard, the values are determined by use of standard spectral luminosity factors previously adopted by the Committee.

Automatic Inspector for Tungsten Filaments

BAYSIDE, N. Y.—A new test instrument for the accurate detection of longitudinal fissures in fine tungsten wires has been announced by Walter E. Kingston, Manager of the Metallurgical Laboratories of Sylvania Electric Products Inc. The new instrument permits all tungsten wire for lamp and radio tube production to be subjected to a rapid physical test which will accurately reveal faults in crystal structure, an important cause of premature failure of filaments used in fluorescent and incandescent lamps and electron tubes. Shown in the photograph is D.

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FOR ACCURATE AND RELIABLE INDICATION FROM REMOTE STATIONS

Initially designed for installation in military aircraft, d-c selsyn instruments are proving to be extremely adaptable to a wide variety of industrial uses. Your design men may find that this equipment is the solution to their problems of remote-station indication.

So that we may be of further service to design engineers, we have just completed an application manual to assist in the selection and use of position-indicating equipment. The three-wire, three-coil system is presented in this manual to the exclusion of the numerous other d-c selsyn systems that have been devised and are available for special purposes. It is the most versatile system and, therefore, the most widely used for general position-indicating applications.

Let our engineers help you with any unusual applications that require special consideration; and for your own free copy of our d-c selsyn position-indicating equipment manual, GET-1304, call your nearest G-E sales office or write to Apparatus Dept., Section C607-12, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

607-12

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Times Telephoto Equipment Inc. announces a change of name to Times Facsimile Corp.

Everything's the same but the name. Times Facsimile Corporation is a wholly-owned subsidiary of The New York Times Company. Management and personnel remain unchanged. The same skilled staff of technicians is working under the same high standards of craftsmanship that have made this organization a leading manufacturer of facsimile equipment for more than a decade.

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W. White, a member of the laboratory staff, who is engaged in the study of the fundamental properties of tungsten wire. Mr. White was primarily responsible in the establishment of the operating principles and the development of the new fissure tester shown at right.

Shock Testing by Means of Crystal Accelerometer

PITTSBURGH, Penna.—A test pilot turns his plane into a dive and soon reaches an acceleration of five times the pull of gravity ($5G$). A turbine when vibrating badly may experience accelerations of 15 G. Such accelerations are experienced for relatively long periods of time. Next consider an acceleration of 5000 G existing for a fraction of a second as caused, say, by gunfire. The measurement of this ultrahigh, split-second movement is one of the problems encountered by the shock-testing engineers at Westinghouse.

Helping them with the problem is a compact crystal accelerometer, which accurately measures shock forces up to 6000 G, and higher forces with less accuracy. This instrument makes use of the piezoelectric phenomenon whereby a change in force on the crystal surfaces causes a charge to appear on the surfaces. The amount of charge is directly proportional to the acceleration. The device weighs but half of a pound. It is connected to a sensitive voltage detector system; and an oscillograph is used to produce the acceleration record. Accelerations up to 8000 G can be measured at frequencies up to 10,000 cps.

Vacuum-tube Acceleration Pick-up

WASHINGTON, D. C.—A new electron tube, appearing much as an ordinary radio tube but capable of measuring accurately the rapidly-changing accelerations to which various parts of an airplane are subjected in flight, has been developed at the National Bureau of Standards under the direction of Dr. Walter Ramberg. The new tube, known as the vacuum-tube acceleration pick-up, is also proving useful in such applications as the measuring of acceleration in portions of the body of "dummy" pilots and living subjects when subjected to critical acceleration during crash landings or seat-ejections from JP airplanes.

The vacuum-tube acceleration pick-up takes advantage of the effect of acceleration on the relative position of the electrodes in the tube. This is in contrast to the design of conventional tubes where this effect is suppressed as much as possible because it leads to electrical noise or microphonics. The tube contains a fixed indirectly-heated cathode with two plates, one on either side. These plates are elastically mounted to deflect in response to acceleration normal to the plane of the

X-ray has its limits

see our CATALOG in SWEET'S FILE for PRODUCT DESIGNERS

OF COURSE, it can't be stopped by a human skull—no matter how thick. But exposure must be held within strict limits . . . for X-ray treatment as well as photography. That can be done easily and *accurately* with a modern X-ray machine when it has a timer operated by a Telechron synchronous electric motor.

This is typical of hundreds of applications for these dependable, versatile motors. For over 25 years Telechron has been the largest producer of synchronous electric motors. Telechron engineers—co-operating with the manufacturers of automatic timing, switching, recording, and control equipment—are working out new applications every day. *Perhaps they have the answer to the timing puzzle confronting you.*

Telechron motors can be adapted to a wide range of electric devices. They can be applied as easily to complicated control mechanisms as to the simplest switches. They're self-starting and reach rated speed almost instantly. Operating in perfect synchronism with all commercial frequencies, *they cannot run faster or slower.* Torque ratings are conservative. This—with precision building and Telechron's exclusive capillary oiling system—assures long, trouble-free service. Telechron motors have been used successfully in clocks and timing devices for 25 years—and more. They're Underwriters Laboratories approved. Telechron's *application engineers* will be glad to discuss your needs. Why not call on them? There's no obligation. Just address Motor Advisory Service, Dept. B, Telechron Inc., Ashland, Massachusetts.

Telechron Motors Are Now Being Used for:

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- Industrial Process and Cycling Timers
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SYNCHRONOUS MOTORS

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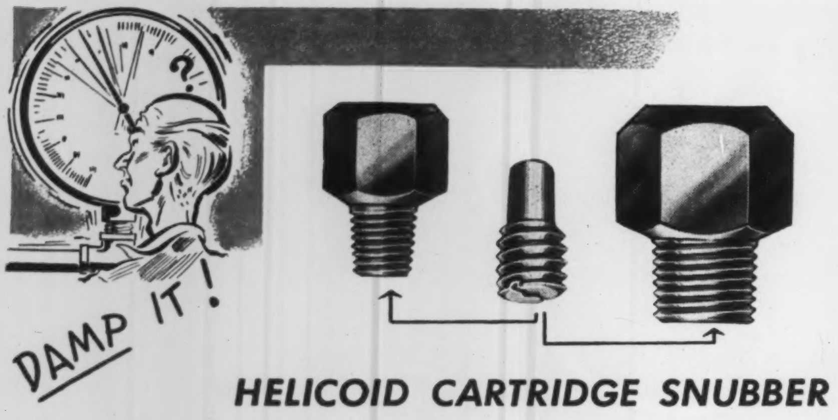

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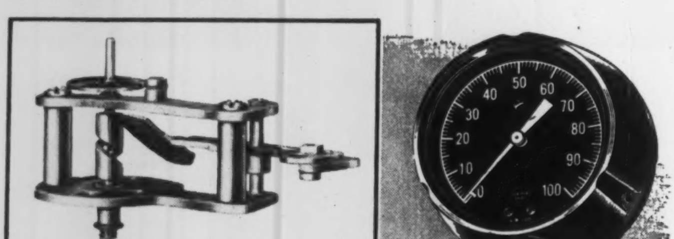

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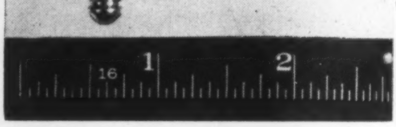
plates. The deflection of the plates causes a change in plate current proportional to the acceleration and such changes in current are recorded on a standard oscillograph.

The elastic mounting of the plates was designed to give a fundamental frequency of about 800 cps. in order to make the tube capable of recording accelerations with frequencies up to 200 cps. Tests conducted at the Bureau of Standards on the latest type tubes (of which 95 have been built) have proved them to have the desired natural frequency with an output proportional to acceleration normal to the plates. The output for an acceleration of the order of 10 times gravity was sufficient to record directly on a standard oscillograph without requiring an auxiliary amplifier.



The use of the vacuum tube is recommended in those applications in which its advantages of high output, high natural frequency, high capacity, and linearity outweigh its disadvantages of zero drift, warming-up time, high power consumption (about 7 watts for tube and Wheatstone bridge) and the need for filtering to remove natural frequency response.

The high output and high frequency of the vacuum tube make it possible to record rapidly-varying accelerations without an amplifier. This is a desirable feature in flight tests of small airplanes where space and weight are at a premium. It also simplifies tests in the laboratory when amplifying channels are not readily available.

The high capacity of the pick-up is advantageous in recording accelerations over a wide range and in preventing damage from sudden high accelerations. The linearity of the pick-up permits the filtering out of high-frequency response, regardless of amplitude, and produces a record proportional to acceleration.

The development of the vacuum tube acceleration pick-up was begun in 1941 for the Navy's Bureau of Aeronautics and was carried on with the coöperation of Sylvania Electric Products, Inc.

Instruments THE MAGAZINE OF Measurement and Control

M. F. BEHAR, Editor

Keep Air Travel Safe by Backing Instrumentation!

IN spite of newspaper headlines and radio news flashes sensationally reporting airplane crashes in various parts of the world, it remains a fact that traveling on CAA-certified planes on regularly-scheduled flights of commercial airlines in the U.S. is safe travel. The National Safety Council's 1946 accident statistics report, issued February 4, states that the airline passenger death rate in 1946 was 1.2 per 100,000,000 passenger-miles, which was 43% below the 1945 rate. This contradicts the alarmingly high fatality "statistics" given during January by the press and radio. The official figure of 1.2 deaths per 100,000,000 passenger-miles is as low as the lowest on record—that of 1939.

Now, what is certain is that for several weeks some (probably most) of the airlines have been operating below the break-even point. What is common knowledge is that nearly all airlines are hard up. What is rumored is that any legislation forcing them to buy millions of dollars' worth of new equipment on short notice and to hire new types of employees requiring special training would greatly embarrass them.

Civil air travel IS safe. It is safe because of the high quality of its men and of its matériel.

(1) The "intangible" factors are the keen intelligence and reasonable policies of the men who have created the industry and fostered its steady growth. *Of all human factors the most important has been the wise division of responsibilities. Up to now, for example, not only all aircraft instruments but all ground instruments such as weather instruments and landing-system instruments have been under the jurisdiction of trained instrument men.*

(2) The tangible factor is the excellence of the planes, engines, instruments and other airborne equipment as well as ground facilities. *Of all material factors, the most important for assuring safe take-offs and landings are the numerous instruments designed for that purpose, many of them automatic and known by names which do not include the word "instrument." Examples: "radar," "ground-controlled approach," etc.*

The two foregoing paragraphs add up to one of the most glorious achievements of our American system of wise private enterprise wisely regulated for the public good. Specifically we have GOOD THINGS (good instruments) efficaciously used by GOOD MEN (expert instrument men, including executives, pilots, ground crews, etc.) under GOOD REGULATIONS (lengthy and technical but to the effect that only the best instruments should be installed in aircraft and on the ground; and only qualified instrument men should specify, operate and service these instruments).

That's all to the good! It must be preserved!

It will be preserved if Congress and the executive departments involved continue to recognize that the safety of air passengers is in expert hands. It would be endangered if new rules suddenly compelled revolutionary (instead of evolutionary) changes in THINGS, MEN AND PROCEDURES. We believe that the most important things are the instruments and that even minor changes in regulations should not be imposed suddenly without the approval of those faithful and expert men who actually *operate* the airlines.

To be specific: newspaper, radio commentators and news weeklies report that public clamor may result in laws compelling airlines to install "amazing new landing systems developed during the war." The facts are that the CAA began to develop instrument landing systems in 1928 (yes, nineteen years ago!) and has improved them ever since with the coöperation of other scientific and technical government agencies and of airlines.*

The pity of it is that some critics are using catchy words—terms which have broad glamorous meanings. They claim that safe-approach instrumentation is all "radio" or "electronics" or "radar" and THEREFORE must be placed under the jurisdiction of radio men. Radio men, they claim, must specify millions of dollars' worth of new instruments; radio men must hire new men and these new men must be radio men.

The instruments involved are INSTRUMENTS. Of course, some of them use wireless transmission of control-instrument functions, of measuring-instrument indications, etc. So what? All of these instruments use special dielectric materials but there is no movement to put these instruments under the jurisdiction of the ceramics industry and of ceramic engineers. Likewise, all these approach and landing instruments use special alloys but the alloys industry and the metallurgical engineers are not moving to "take over."

"Radio men" as a group and "electronics men" as a group do not possess the special qualifications of instrument men as a group. There are exceptions in that SOME radio men and SOME electronics men are instrumenticians. (For example, most of the designers at the General Radio Company are instrument designers because that company is essentially an instrument company. Also, in the electronics industry, there are men whose work is essentially instrument work.) But this is true in all professions: there are SOME chemists, biologists, criminologists, patent agents, purchasing agents, etc., etc., who specialize in instruments. The overshadowing consideration is that *aviation instruments belong to instrument men*—logically, rightfully, and for the protection of the public.

Congressmen, newspaper editors and other public leaders are vaguely aware that there would be no air transport industry today if hundreds of types of new instruments had not been invented and perfected. But what is generally ignored is that these instruments must be used and maintained by experts—from pilots and navigators who must pass their instrument exams, to the unsung repairmen who must have received from one to four years of special training.**

—MFB

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*See the first Special Aviation Issue of *Instruments* (Oct. 1941) for several articles bearing on this subject—especially "The CAA and Industry Coöperate to Develop Instrumentation" by C. I. Stanton, then Deputy Administrator of the CAA, in which Mr. Stanton gave a "readable" illustrated technical description of the instrument landing system. See also the Second Special Aviation Issue of *Instruments* (April 1942) for other such articles.

See also the *Aviation Instruments* Department in every issue from June 1942 to Dec. 1945, for a number of outstanding articles—both technical and semi-popular. Among the articles by CAA experts, we call special attention to "Future Developments in Instrumentation for All-weather Air-traffic Control" by Glenn A. Gilbert in the April 1945 issue.

**Yes, four years and even more to qualify for the higher grades of Instrument Mechanic or Instrument Repairman. We printed a number of articles on the training of aviation instrument men between 1939 and 1945. They deserve to be studied.

Control of Reactors for Synthetic Rubber[*]

By **E. E. ROWLAND**, Government Laboratories Operated by The University of Akron (Agent), Akron, Ohio

SYNTHETIC RUBBER, within the last few years, has played a major rôle in many of our modern products. The height of its importance was probably reached during the recent war when this country depended so largely upon it. In view of the multitude of new applications of synthetic rubber, there is every reason to believe that this versatile material will continue to occupy an enviable position in our peace-time economy.

Instrumentation, a vital feature in any successful process, is no less important where synthetic rubber is concerned. It is the purpose of this paper to point out some experiences with control devices that may be of value to operators and engineers in other fields.

A consideration of instrumentation, as applied to synthetic rubber, may well begin with a study of the process itself. The polymerization of synthetic latex, from which the rubber is ultimately made, has some characteristics that tend to make the product non-uniform. The great majority of manufactured GR-S (Government Rubber-Styrene) has its origin in the monomers butadiene (72%) and styrene (28%). For each 100 parts of this blend, approximately 180 parts of water and 5 parts of soap are added. In addition, small quantities of various types of modifiers and catalysts are employed to obtain the proper reaction. The emulsion formed with these charging materials is, of course, not extremely stable and it must be agitated constantly throughout the period of polymerization. The reaction is not allowed to run to completion, since the most favorable qualities are attained at less than 100% conversion of the total monomers.

Butadiene, the most volatile component, must be kept under a pressure of 30 to 40 lbs./in.^{2} at normal temperatures to retain it in a liquid state. The temperature that has been used most consistently for polymerization is 122°F. (50°C.). It has been found necessary that the temperature be held constant throughout the reaction. It appears that if heat is added too rapidly to an emulsion of this type, the liberated gas from liquid butadiene tends to form finely-diffused bubbles which alter the intrinsic properties and decrease the coefficient of heat transfer. This evolution of gas impairs the accuracy of control, especially since the rate of reaction is stepped up at the same time.

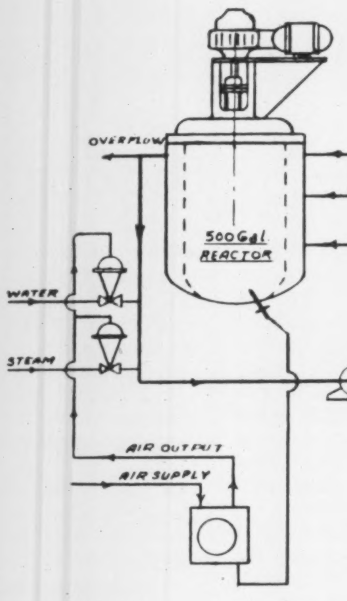

Fig. 1
SINGLE INSTRUMENT

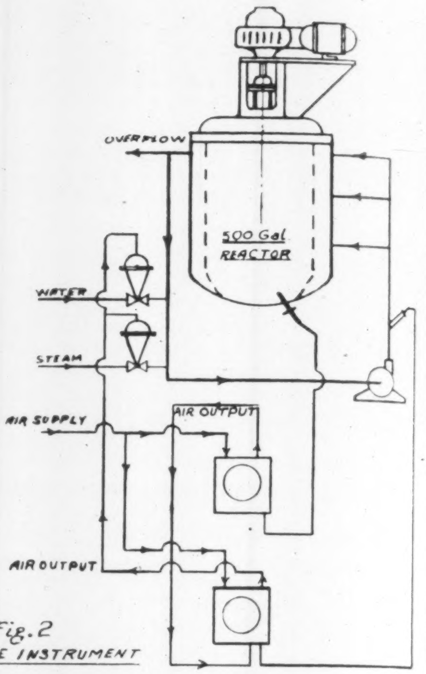

Fig. 2
DOUBLE INSTRUMENT

CHARACTERISTICS OF 500-GALLON PILOT PLANT REACTOR FOR SYNTHETIC RUBBER

Total Capacity—547 gallons
Vessel—5/8" Shell, glass-lined, 1/8" to 5/16" thick
Capacity of Jacket and Circulating Water Piping—140 gallons
Flow of Circulating Water—78 g.p.m.
Agitator—Two 16" Split Turbine type (Blaw-Knox)—205 r.p.m.

APPROXIMATE CHARGE FOR GR-S RUBBER

72% Butadiene, 28% Styrene	**100 parts**
Water	**180 parts**
Soap	**5 parts**

Varying amounts of Modifiers and Catalysts
Usual reaction time, about twelve hours

The standard plant reactor, or autoclave, holds about 4000 gallons, but in this discussion we shall consider our Pilot Plant reactor which was built to charge 500 gallons and which has a total capacity of 547 gallons (Fig. 1). The temperature of the batch is maintained by a jacket around the reactor through which water is circulated and, in order to obtain proper heat transfer to the material as well as to hold the emulsion, an agitator is in con-

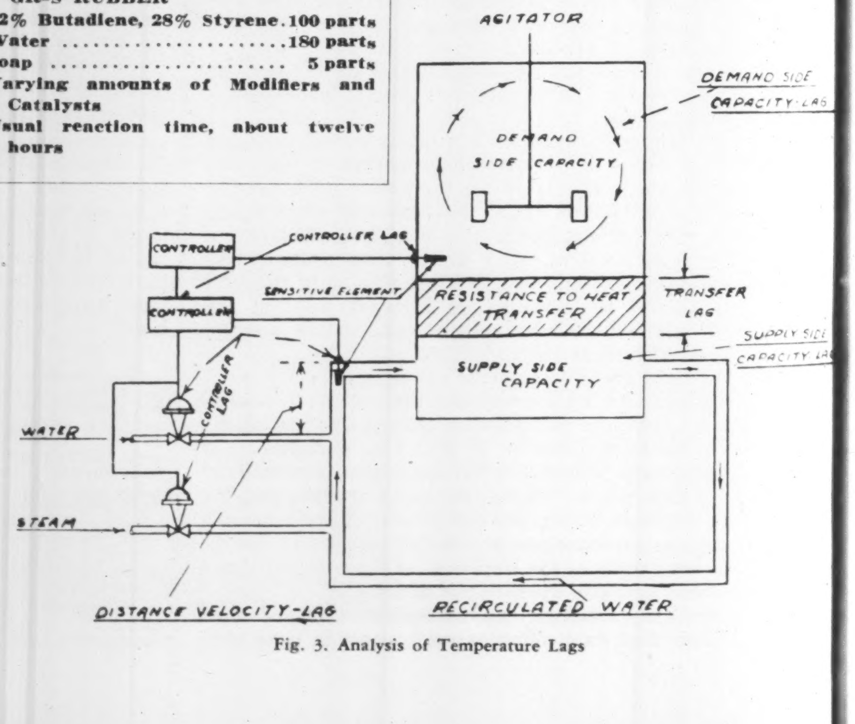

Fig. 3. Analysis of Temperature Lags

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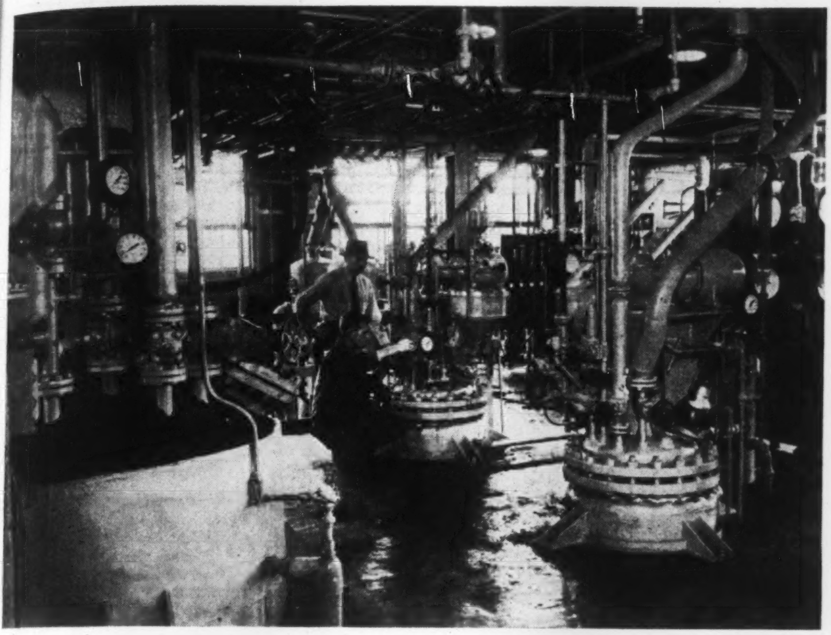
[*] Presented at the first Annual Conference of the Instrument Society of America, William Penn Hotel, Pittsburgh, Penna., Sept. 16-20, 1946.

NOTE: Statements and opinions advanced in papers are to be understood as individual expressions of their authors and not those of the Society.



View in the large reactor area showing one 500-gal. reactor in the left foreground and the tops of two 80-gal. reactors at the right. Immediately behind the men are the foam traps over the strippers for the 80-gal. reactors. In the background are the control panels for these reactors and the 10-gal. continuous unit.

stant operation in the batch. The jacket water is circulated at about 80 gpm., being discharged tangentially from the circulating pump through four nozzles in the jacket to maintain sufficient turbulence. It then passes through an overflow return pipe to the suction side of the pump. Steam and cooling water are admitted through the valves operated by the automatic-control instrument. Best results are attained by overlapping the travel of the valves in such a way that there normally is a flow of both steam and water to the circulating line. Settings are such that the steam valve is closed and the water valve is wide open at 1 lb./in.^{2} pressure at the outlet from the temperature controller. At 7 lbs., the steam valve starts to open; at 11 lbs. the water valve is completely closed, and at 14 lbs. the steam valve is completely open.

The temperature lags are a little peculiar in that there is a blending action in the jacket (Fig. 3) or a primary capacity lag, and there are insulating effects ascribable to the shell of the reactor which is ⅝″ thick, and to the glass lining which varies from ⅛″ to 5/16″ in thickness. The transfer through glass and a probable coating of rubber, plus the poor thermal conductivity of the latex and the capacity lag of the batch, all tend to cause slow response to valve changes (see Fig. 5).

In Fig. 6 it will be seen that more than an hour is required to bring the charged materials to the operating temperature with the jacket temperature at 148°F. It has been considered best to allow no more than a 30° differential on the heating side, for many tons of material have been lost because of initial overheating of the batches. As the chemical reaction speeds up, a point is reached where no amount of cooling from the jacket seems to affect the batch, hence the relief valves are set to open at 125 lbs./in.^{2}. The total heat given off varies from approximately 550 to 640 B.t.u. per pound.

The temperature controllers originally supplied had throttling ranges or proportional band adjustments and automatic-reset mechanisms. However, any combinations of settings tried produced more or less serious and continuous cycling, the period of which was ½ to ¾ of an hour (Fig. 8). It was found that good control was realized by removing the automatic-reset action. This arrangement, even with a narrow throttling range, allows some deviation from the setting point as the load changes; the deviation, of course, is in proportion to the load. The normal time of reaction is about 12 hours and the maximum heat evolution occurs between the 7th and the 9th

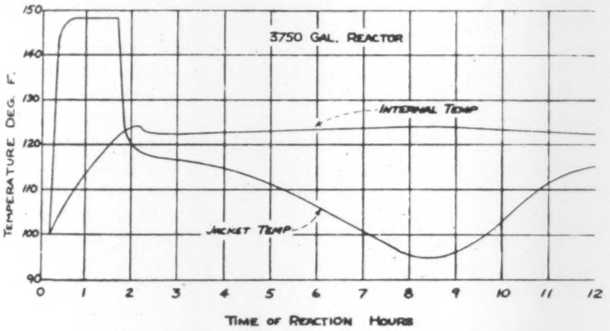


Fig. 4. Typical Standard Plant Temperature Record

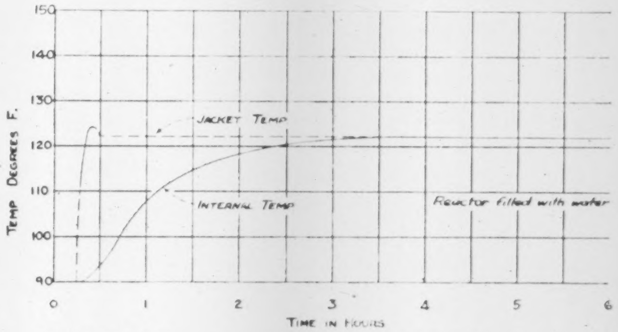


Fig. 5. Total Temperature Lag with 122°F. Jacket Temperature

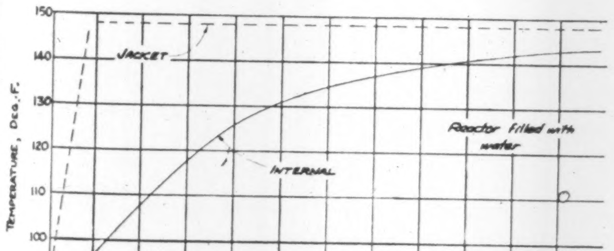


Fig. 6. Temperature Lag to 122°F. with Jacket at 148°F.

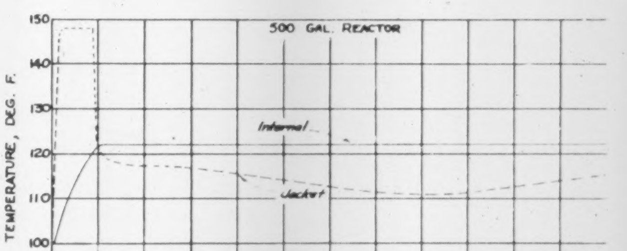


Fig. 7. Four Records of Various Instrument Settings

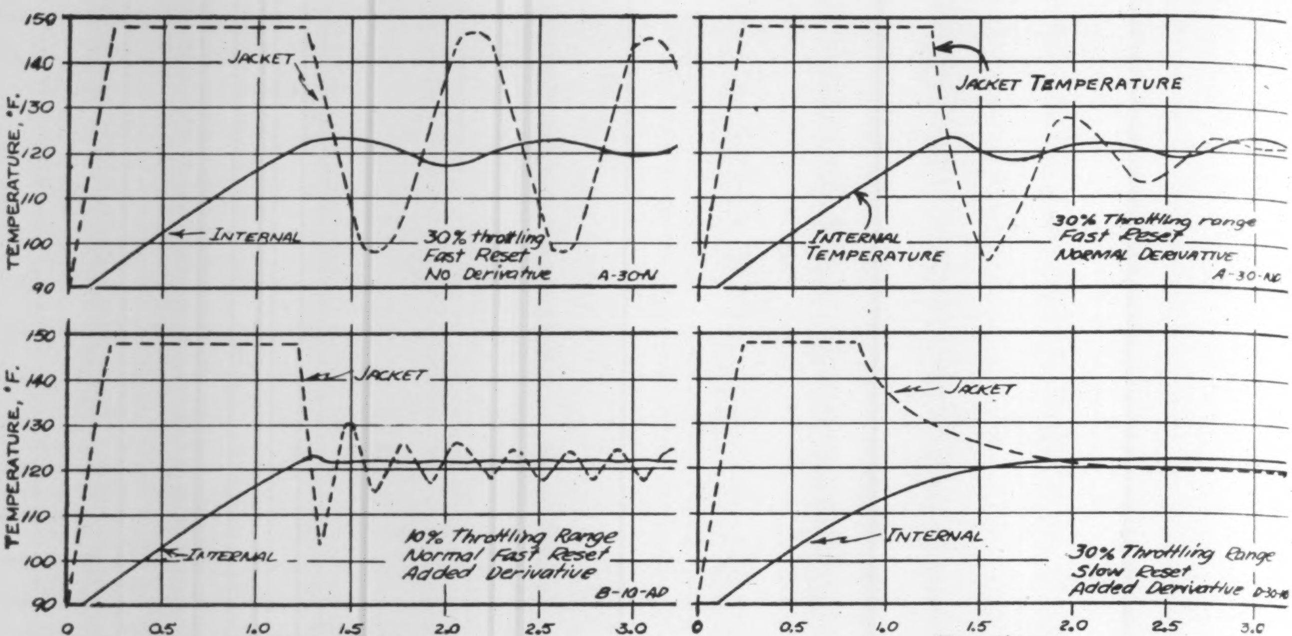


Fig. 8. Temperature Record for 500-gallon Reactor with present Double Instrument Control

hours. Through this period also is the peak of apparent viscosity of the emulsion and, therefore, the cooling-water requirements are several times greater than at the start or near the end. In Fig. 4, a normal run (for a standard plant reactor with one instrument), the jacket water has started out at 117°F. after the batch has arrived at the proper temperature; during the peak of reaction the temperature of the jacket water dropped to as low as 95°F. in order to maintain the internal temperature of 122°F. This caused the actual temperature to increase to 123.5°F.

For most commercial work, the deviation of a degree and a half to two degrees is not serious. In Pilot Plant work, however, one must do better if one expects to make any reliable calculations as to heat evolutions of the various latices. These studies were made with a differential "Therm-Ohm" recorder having a range of −5 to +5; steady control and accurate temperatures are necessary. These requirements cannot be met with one instrument having extremely slow automatic-reset speed and having a high derivative action without having the positioning of the valves slightly ragged. Many factors, including vibration, severely affect an instrument of this type.

A primary temperature controller (Fig. 2) is of practical value. This controller has its bulb in the batch and it sets, pneumatically, a second control instrument which is affected by the temperature of the circulating water. Several advantages are obtained by having fairly wide throttling range and low automatic-reset speed in the second instrument. Slight fluctuations in cooling-water temperature and steam pressure are effectively leveled out as well as the roughness of the high derivative action in the primary instrument. A few difficulties have been encountered in an attempt to get good instrumentation but the present system is highly satisfactory.

Attention should be called to an interesting and important feature, not previously mentioned, which is encountered at the start of this run. With this system of instrumentation, there is a response action of the primary controller which appears to be of value. To assume control of a varying medium before it arrives at the setting point is a problem worthy of much investigation. Shown in Fig. 7 is a typical curve of the polymerization temperature record and its controlling-medium temperature. Note that the approach is ideal in that it prevents initial cycling and also maintains excellent control. It has been claimed in advertisements that the derivative action in an automatic-control instrument is an "anticipatory effect." If this is so, the action of this temperature controller is *psychic!*

It is apparent that the time required for complete return to balanced pressure in the automatic-reset mechanism is much longer than is usually encountered in chemical process control. When so much time has elapsed in bringing the charged material to operating temperature, it would be expected that the instrument would not attempt to gain control until after the temperature curve has crossed the setting point and, at best, one would expect to get a few short diminishing cycles until it levels off. In this case, however, the derivative action takes effect several degrees before the batch arrives at the setting point (Fig. 7), and it stops the rise in temperature. Of course, the time between the setting-up of the pointer and the arrival of the batch at the control temperature is important and an attempt has, therefore, been made to standardize the charging temperatures so that this time lag may be uniform. Slight variances in time, though, have not been as serious as one would expect because of the asymptotic approach of reset to equilibrium. The response of the controller in this manner is due to the fact that the instrument which had been set at zero pressure and which had been balanced out before the start, is in the process of resetting at 15 lbs./in.^{2} when the temperature arrives at the setting point.

The pointer of the primary instrument should be lower than the charging temperature of the batch for at least two hours before the batch is started. If this setting cannot be obtained, one must open the automatic-reset by-pass and make sure that the system is balanced to zero pressure before elevating the pointer to the operating temperature. The fact that the instrument has not completely reset at 15 lbs. allows the derivative mechanism to come into play before the control temperature is reached. With the combination of flow ratios of the controlled valves, plus the effective high derivative action and slow automatic-reset speed, the jacket temperature is suddenly changed 30° to 40°F. for a 1° to 3°F. rise in the temperature of the batch. Considerable data have been obtained which might help to calculate optimum settings of the instrument but, so far, the procedure has been largely of a cut-and-try nature. It is possible to hold temperatures within ¼°F., and good results are obtained in the recording of the differential "Therm-Ohm."

Studies of the heat of reaction, as well as methods of control, both by jacket temperature and by refluxing butadiene directly into the batch, are being undertaken.

Controls for the Chain-reacting Pile

By E. C. CREUTZ, Carnegie Institute of Technology, Pittsburgh.

BEFORE we start the discussion of the controls for the chain-reacting pile, it will be convenient to become a little familiar with some of the facts of nuclear fission which make the chain-reaction possible. First, we need to define the term "cross-section." The cross-section of a nucleus for a nuclear reaction is a measure of the probability that the reaction will take place when the nucleus is exposed to the conditions which make it possible. More specifically, let us talk about the cross-section for collision of a neutron with a uranium nucleus. Let us suppose we have a beam of neutrons moving with velocity v. Let there be n neutrons per cubic centimeter of this beam. Let there be one uranium nucleus in the path of this beam and also let the effective projected area which this nucleus exposes to the neutron beam be σ. For convenience, let us change our reference system so that the neutrons are standing still and the nucleus is moving with velocity v through the neutrons. Each second, the nucleus will then sweep out a volume of space defined by a cylinder, the area of whose base is σ and whose height is v. The volume of the cylinder is then $v\ \sigma$. However, since there are n neutrons per cubic centimeter in this space, the number of collisions this nucleus will make with a neutron per second is $n\ v\ \sigma$. σ may then be defined as the number of collisions per second divided by $n\ v$.

The cross-section σ should not be thought of as an actual geometrical area of the nucleus since it is found experimentally that its value as defined above will depend on the particular type of experiment that is being done. Thus the cross-section σ for a neutron hitting a uranium nucleus to produce fission will be different from the cross-section for it to be simply absorbed in the nucleus.

Let us now make use of this definition to further define some of the properties of uranium nuclei. Natural uranium consists mostly of the isotope U^{238}. About one part in 140 is U^{235}. The cross-sections for interactions with neutrons differ for these two kinds of uranium nuclei and also depend upon the energy of the neutrons. U^{235} will capture slow neutrons and nuclear fission will be produced. The cross-section for this kind of capture varies inversely with the velocity of the neutrons. U^{238} will capture slow neutrons but no fission is produced by them. Instead, the new nucleus, U^{239}, is formed. By the emission of two beta rays this nucleus then becomes Pu^{239}. The cross-section for this kind of capture also varies inversely with the velocity of the neutrons except that when the neutrons have a few electron volts of energy, a narrow region of energy is found where the cross-section is very greatly increased. Similar narrow regions of energy where the cross-section of absorption of neutrons by U^{238} is very great are found all the way up along the energy scale. U^{238} will not undergo fission on neutron capture unless the neutron has more than about a million electron volts of energy. When a uranium nucleus does undergo fission, about 2½ new neutrons are produced and some of these have an energy greater than a million electron volts.

With these ideas in mind, it might seem possible to produce a chain reaction in uranium if all the neutrons were of very low energy where they would produce fission in U^{235} with a large probability or if the neutrons were of energy greater than one million electron volts when they would have a good chance of producing fission in U^{238}.

However, let us look a little more closely at the figures. Of the approximately 2½ neutrons produced per fission, on the average about one is below the energy which can produce an additional fission in U^{238}. This one has about one chance in twenty of producing fission in U^{235}. Of the 1½ which are above this fission producing threshhold, about 1¼ of them would be successful if it were not for the fact of inelastic scattering. That is, a fast neutron has a certain chance of colliding with a uranium nucleus, not producing fission, but merely losing some of its energy which will be radiated in the form of a gamma ray. This accounts for the fact that only about 2/10 of a neutron on the average does produce a fission while it is fast. Therefore, in pure uranium no chain-reaction is possible.

If the 2½ neutrons became slowed down to very low energies, about 1.3 of them would cause fission and 1.2 would be absorbed, ultimately to produce Pu. The trick, therefore, is to slow these neutrons down without losing them.

If a particle of mass m collides with a particle of mass M which is stationary, the laws of conservation of energy and momentum show that on the average the fraction of its energy lost is $f = 2\,Mm/(m + M)^2$. This loss is a maximum when $M = m$. Therefore, to slow neutrons down as rapidly as possible it would seem desirable to mix with the uranium some substance, the mass of whose nuclei is very close to the mass of the neutron. This immediately suggests hydrogen, since the proton is very near the same mass as the neutron. However, another fact must be considered and that is the probability of absorption of the neutron by the slowing-down material. It turns out that, considering the cross-section for absorption of neutrons by various elements, there are much better things to use than hydrogen. Table I lists the first six elements in the periodic table with rough values of their absorption cross-sections for slow neutrons, the fraction, f, of neutron energy lost on the average by a collision with the nucleus of the material, the cross-section for a scattering collision of the neutron with a nucleus, f times this cross-section, and finally f times the scattering cross-section divided by the absorption cross-section. This last column may be considered as a sort of figure of merit for the nucleus as a slowing-down material since if it is large there will be a relatively large number of collisions with an appreciable energy loss and not much chance of wasting the neutrons by absorption in the material. It is seen that helium would be an excellent material but since this is not easily obtained in a high-density form its use is impractical. Lithium and boron are extremely poor because of their large probability of absorption of slow neutrons. Beryllium and carbon are both good. The easy availability of carbon in the form of graphite has made it a practical choice.

TABLE I

	σ^a	f	σ^s	$f\sigma^s$	$\frac{f\sigma^s}{\sigma^a}$
H	0.3	0.5	20	10	30
He	0	0.3	1.5	0.48	Large
Li	60	0.25	6	1.5	0.02
Be	0.007	0.22	6	1.3	185
B	700	0.16	6	0.96	0.001
C	0.004	0.14	5	0.7	175

The next question is how should the slowing down material, in this case, carbon, be mixed with the fissionable material, uranium, to make the maximum use of the neutrons? If a homogeneous mixture of the two materials is made it is found that there is still too much absorption in uranium. The trick then is to lump the uranium and imbed these lumps in the slowing-down material. This may be understood if we remember that the cross-section for absorption of neutrons by uranium shows a large number of sharp resonances. If a more-or-less continuous spectrum of neutron energies then falls on the surface of the uranium lump, just those neutrons which have energies corresponding to these sharp resonances will be absorbed at the surface of the uranium. The spectrum which gets into the lump will then be deficient in just those energies which are strongly absorbed. Therefore, there will be little absorption inside the lump. On the

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*Presented before the Pittsburgh Physical Society, September 18, 1946.

other hand, if there were slowing-down material *in* the lump, some of the neutrons with energies which are just above the resonances would be slowed down into them and be wastefully absorbed inside the lump.

Let us now review the above facts and show how they may be combined into the reproduction factor of a chain-reacting arrangement. By the reproduction factor, we mean simply the final number of neutrons which are made available by this process by one initial neutron in one cycle or generation. This will be more clear from the following discussion. Let us start the process with one neutron in a uranium sphere. $1 + \epsilon$ will come out because there is a certain chance that the fast neutron will cause fission in the sphere and additional neutrons will be produced. The number of these that become slow neutrons will be $(1 + \epsilon) \times (1 - f_r)$, where f_r is the probability that a neutron is absorbed either in uranium or carbon while being slowed down. The number that are absorbed by uranium is then $(1 + \epsilon) \times (1 - f_r) \times f_t$ where f_t is the probability that a slow neutron is absorbed by uranium. Finally, the number of new neutrons produced from this one neutron, which quantity we have defined as the reproduction factor k, will be $k = (1 + \epsilon)\ (1 - f_r)\ f_t \times \eta$, where η is the probability that the absorption of a slow neutron in uranium causes fission × the number of neutrons produced per fission. Let us look at some rough figures which one might find in a typical chain reacting pile. $1 + \epsilon = 1.05$, $1 - f_r = 0.88$, $f_t = 0.88$, $\eta = 1.3$, $k = 1.07$.

The number of neutrons in the pile will then increase exponentially with time according to the following equation:

$$N = N_o \exp\left[(V/\Lambda)\ (k - k_o)\,t\right]$$

where Λ is the mean free path for absorption of the neutron and k_o is the reproduction factor for a pile that is just barely chain reacting.

If one computes the generation time from data such as given above, he obtains a value of about 1/1000 of a second. Control of such a device would be extremely difficult under these conditions. However, it is fortunate that not all neutrons produced by fission are given off immediately during fission. About 1% of them—the so-called delayed neutrons—are given off more slowly and the half-lives of these slower processes are known to be approximately 57 seconds, 24 seconds, 7 seconds, and 2½ seconds. Thus it is possible to operate a chain reacting pile making use of this 1% of delayed neutrons, and the generation time including this effect is more like 1/10 of a second. By adjusting the amount of spurious neutron absorption in the pile, the exponential period may be made as long as desired and is frequently made to be minutes or hours.

Let us now discuss some of the types of apparatus which are used to control the pile. The most sensitive instruments used are those for detecting radiation. The pile is a source of neutrons as well as gamma and beta rays. Several instruments detecting these various radiations are used. A fundamental instrument is the ionization chamber which consists of two metal plates in a chamber filled with some gas. If a gamma ray strikes an atom in the wall of the chamber or the gas, it may knock out an electron which, going through the gas, produces ions. These ions are attracted to one or the other of the charged electrodes, producing a small current. If the electrodes are connected to a battery through a high resistance the passage of this small current through the chamber and the resistance will produce a voltage across the resistance which may be amplified by standard electronic means. The detection of a neutron is necessarily a somewhat less direct process since a neutron must produce a collision with a nucleus before any ionizing particles are available. This collision may be simply a scattering process, for instance the neutron may hit a hydrogen nucleus and cause it to recoil and to produce ions in the gas. Or it may be an actual nuclear transmutation. A reaction commonly used for this is $B^{10} + n \rightarrow Li^7 + He^4$. In this case the He^4 or alpha particle is released with considerable energy and produces ions in the gas. Another reaction that may be used to detect neutrons is the fission reaction. If the ionization chamber walls are lined with uranium the fission fragments produce ions in the gas.

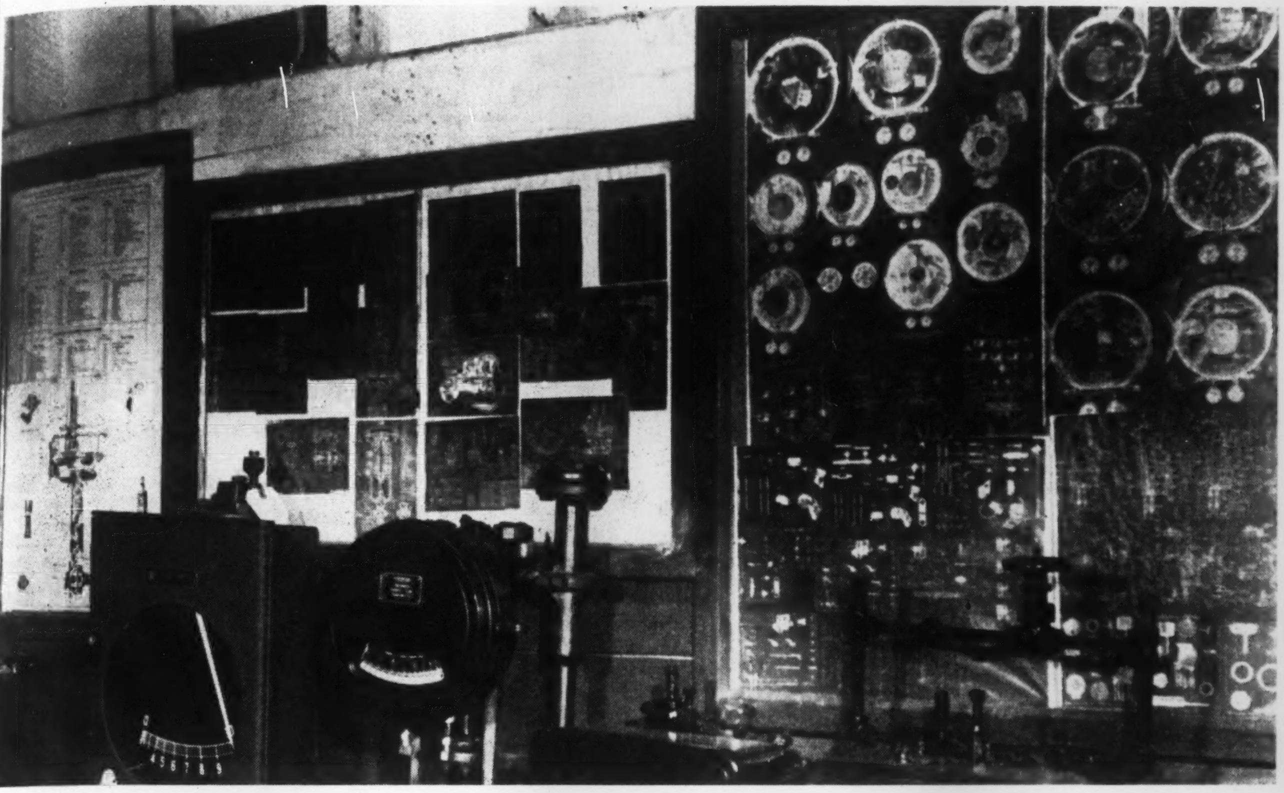
The voltage obtained by amplification of the output of the ion chamber is used in various ways. For many experiments it is desirable to keep the radiation level in the pile extremely steady. If for one reason or another, the radiation starts to increase this will be noticed by an ion chamber placed in or near the pile. The voltage received from it is compared with that of a standard cell in a balanced circuit so that any unbalance is fed to the field of an Amplidyne. The Amplidyne controls a strip of neutron-absorbing material, changing the amount of it extending into the pile. Boron or cadmium containing materials are usually used for this purpose. When it is desired to change the level at which the pile is operating, this may also be done by changing the extent to which a cadmium strip penetrates the pile. Such a device may consist of a cadmium strip on a rack and pinion, the pinion connected by a worm gear to two motors which buck each other. A change made in the field of one of these motors will then allow motion of the gear and hence of the cadmium. The position of the strip is indicated by means of a Selsyn attached to the driving pinion with an indicating selsyn dial on the operator's control board.

An important device in a pile is the safety rod. This may consist of a cadmium strip supported above the pile by means of a magnetic clutch. The magnetic clutch is held clamped by a field which is cut off by a signal from the ion chamber. Thus if the radiation rises above a predetermined value, the cadmium strip drops into a hole in the pile, accelerated by gravity plus an additional force given by a spring. The chain reaction is thus quickly stopped.

There are two rather special types of instruments used in the pile which I should like to mention briefly. It is important to monitor the neutron density in the pile at various times. It is difficult to do this with an ordinary ion chamber because the intensity is so great. A possible scheme is to make use of the fact that neutrons induce artificial radioactivity in many materials. If a tape or ribbon of some such material, say pure silver, is run through the pile at a constant speed, the amount of activity induced in it will be proportional to the neutron density. Such a tape is then run over pulleys past Geiger counters which will measure the induced radioactivity. It is necessary that the tape be sufficiently long and the half-life of the radioactivity be short so that the device may be used continuously and the activity from one passage through the pile will have decayed sufficiently so as not to interfere with the measurement of the next passage through the pile. Such a device as this is unique in that it is not at all sensitive to gamma or beta radiation, depending for its operation on a nuclear reaction which can be produced only by neutrons.

Another important device is one for monitoring the cooling water which leaves a water-cooled chain reactor. Since uranium is rapidly corroded by water, it is necessary to use a protective coating of aluminum. If a leak in this coating develops, water penetrates and can quickly cause considerable damage. It is, therefore, important to have some device for knowing immediately when a break occurs. If one measures the radioactivity in the water issuing from the pile, it will ordinarily be largely due to induced activity in the impurities of the water. If a break in the aluminum occurs this activity will be increased but such an increase cannot be detected rapidly enough by ordinary means. However, it is possible to make use of the delayed neutrons from fission for this purpose. The uranium which is corroded and carried by the water will also carry the elements which are the parents of the delayed neutrons. Thus, ordinarily the radioactivity in the cooling water from the pile will consist only of gamma and beta rays. However, if there is a break in the protection of the uranium the radioactivity will consist also of neutrons.

Therefore, a detector which is specific for neutrons, such as those discussed above, will be useful in this case.



Diagrams and "exploded views" of widely-used instruments are displayed on wall near where work on these instruments is done.

Shop and Equipment Requirements for an Instrument Department in a Large Process Plant*

By WILLIAM H. FORTNEY, Humble Oil & Refinery Co., Baytown, Texas

BEFORE discussing the "Shop and Equipment for an Instrument Department," it might be well to discuss to some extent the organization which will use this equipment, and its functions. From this it will be easier to develop the justification for various facilities and for their utilization.

The basic function of an Instrument Department in a process industry is to maintain instruments which measure, indicate, record, and control the physical and chemical characteristics of the substances being processed, and the processing conditions.

Included may be specialized instruments used in inspection of the products; either at various stages of the processes or in the laboratories.

It is the function of the Instrument Department not only to know the mechanics of instrumentation but to have a working knowledge of its application to the processes: thus a knowledge of the processes is necessary for successful instrumentation.

Maintenance organizations are usually considered as burdens on process industries. This classification cannot be avoided regardless of how vital each type of maintenance. The object in operating a business is to make products of acceptable quality in sufficient quantity to supply demand, and to make a profit for the industry.

Therefore, the ultimate objective of instrumentation in a process is produc-

Machine shop section.

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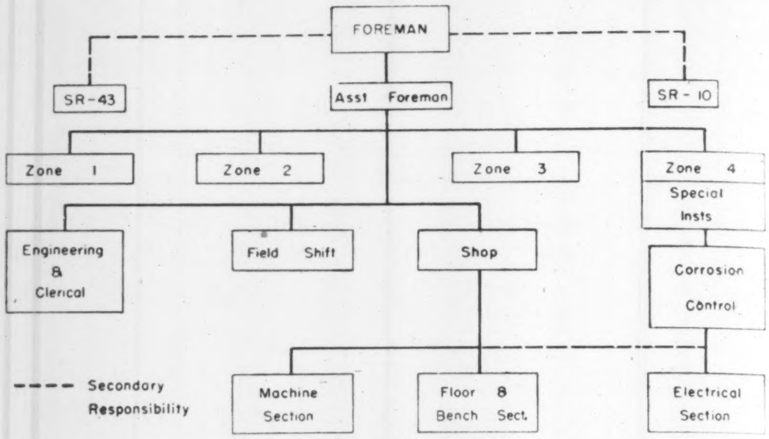
*Presented before the New Jersey Section, Instrument Society of America, December 3, 1946.

tion. In simpler words, the payoff is on the instrument panel indicating that on-test products are going to storage. This means that the organization should point toward good results in the field. If the foregoing statements are correct, then our organization will be built with the field group as the nucleus, with all branches or sections of the department aligned in support of the field. This article from this point on will be a mixture describing the Baytown Instrument Department of the Humble Oil and Refining Company, either as it now exists or as we would like to have it.

The Department includes four main sections: field, shop, engineering and clerical, and special instruments. These are subdivided as necessary.

Before describing in detail any of the functions it might be well to list the instrument items being serviced by the organization. The figures in Table I are approximate and include only the Baytown Refinery. As will be shown later, the Refinery Instrument Shop services two rubber plants which do not show up in the list of instruments.



There are also a number of special instruments such as three mass spectrometers, infrared and ultraviolet spectrophotometers, spectrographs, gravitometers (gas and liquid), titrameters, time cycle controllers, smoke density recorders, etc.

In addition to the instruments listed in Table I, the Department is responsible for several major types of equipment which may not be specifically classed as instruments. These include 9 chlorinators, 46 ejectors, 2,500 relief valves, and 2,500 sections of gage columns.

TABLE I—INSTRUMENTS SERVICED BY INSTRUMENT DEPARTMENT IN BAYTOWN REFINERY

Thermoelectric pyrometers and resistance thermometers	400
Temperature controllers (pyrometric)	100
Pneumatic transmitters (various types)	425
Pressure indicators and recorders	6,300
Pressure regulators	370
Pressure controllers	420
Liquid level controllers	633
Thermal systems (including indicators)	711
Thermal systems, controllers	118
Alarms and signals	235
Displacement meters (liquid and gas)	310
Control valves (pneumatic and hydraulic)	1,636
Analyzers (O_2, CO_2, combustible gas, etc)	14
pH and conductivity instruments	12
Flow indicators and recorders	1,160
Flow controllers	400

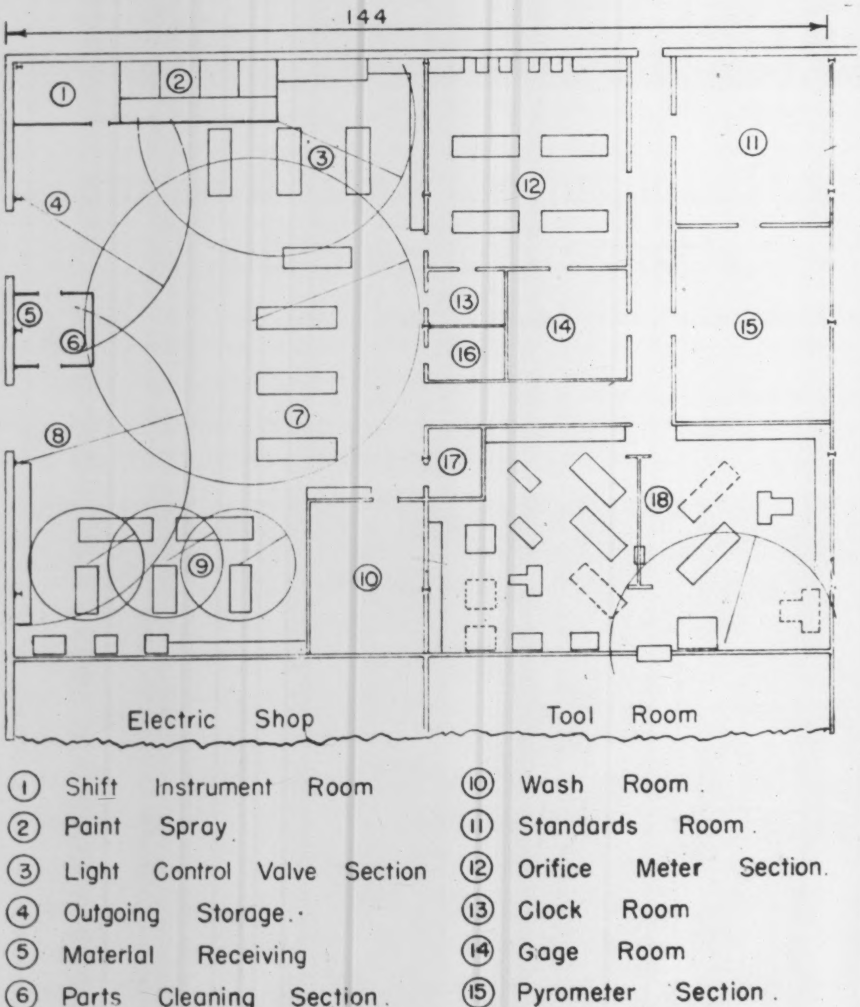
The Department also operates a corrosion control section which stocks and distributes anhydrous ammonia to the various units. Corrosion control in this instance also indicates actual operation of the ammonia system with adjustment of the injection valves at all points of consumption, and pH readings for control of these adjustments.

Chlorinator maintenance includes maintaining stock and distribution of chlorine.

Another responsibility which may be classified as "non-instrument" is that of pre-heating, stress relieving, and annealing of pipe, fittings, and vessels.

Instrument maintenance requires a knowledge of skills borrowed from or overlapping many mechanical crafts, in addition to a working knowledge of the process. Examples are machinist, pipefitting, electrical, sheet metal, painting, welding, blacksmith, and a little of others.

No mechanic could learn all of the crafts and have any time left for instrument work; neither is it necessary for a complete knowledge of any of the crafts mentioned. Instrumentation is equally related to the process and



① Shift Instrument Room
② Paint Spray
③ Light Control Valve Section
④ Outgoing Storage
⑤ Material Receiving
⑥ Parts Cleaning Section
⑦ Heavy Control Valve Section
⑧ Incoming Storage
⑨ Safety Valve Section
⑩ Wash Room
⑪ Standards Room
⑫ Orifice Meter Section
⑬ Clock Room
⑭ Gage Room
⑮ Pyrometer Section
⑯ Shop Office
⑰ Material Entering & Leaving
⑱ Machine Section

operations and a division should be drawn between the shop and the field after a training period which may be fixed to suit the needs of any particular plant. It is proposed to confine the bulk of our remarks to organization and maintenance of an instrument shop.

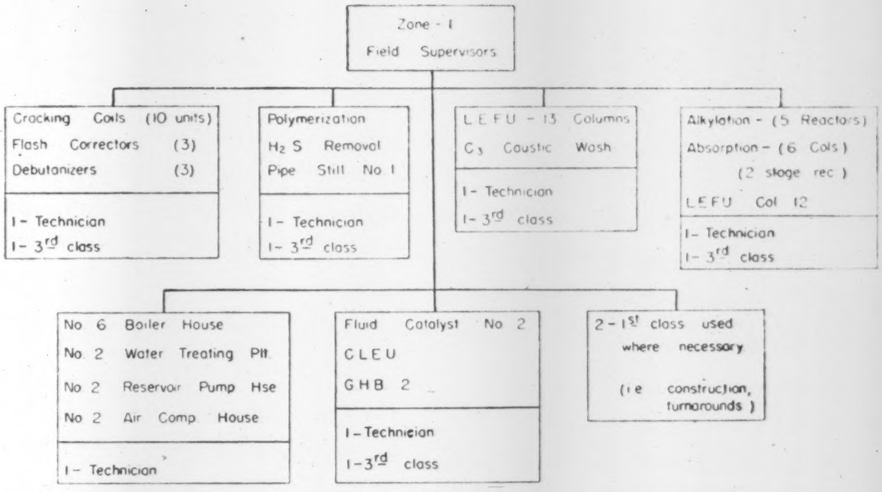
At present, there is no uniformity in the design or even in the scope of work covered by instrument shops. Few shop organizations have been in existence more than ten or fifteen years. Some shops limit the work to the smaller items such as clocks, pressure gages and pyrometers, and make minor field repairs to control valves and other heavy items. We believe in covering the entire field with the Instrument Department organization if possible.

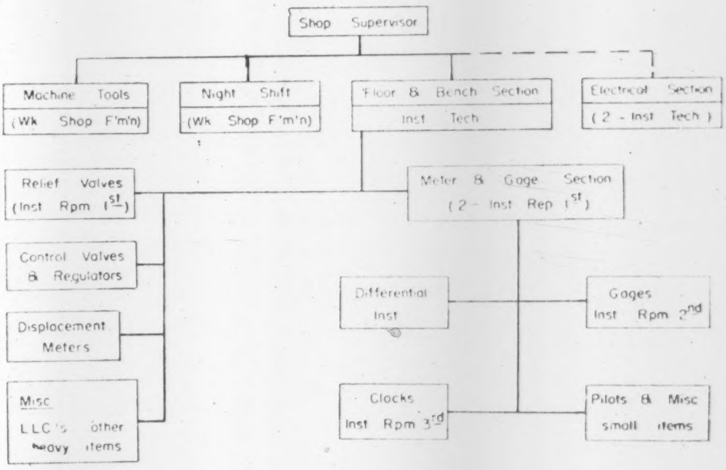
PURPOSE OF MAINTAINING SHOP

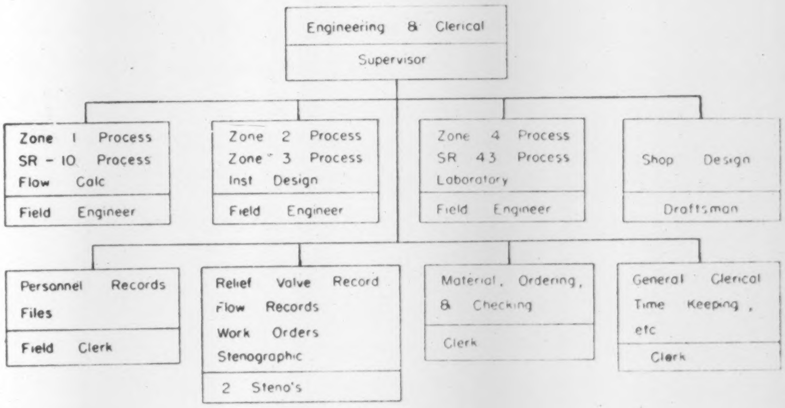
Instruments may represent from five to fifteen percent of the total plant investment. In pilot units or small commercial units, the percentage may run to almost half the investment. The plant which employs more than ten or twelve full-time instrument repairmen should have an instrument shop separate and independent from other departments. In the shop should be concentrated such equipment as is necessary to repair and calibrate the instruments used in the plant. This includes such machine tools as would be in use as much as twenty-five percent of the allotted working time. Machine tools will be discussed later. The department offices should be near the shop so that all records of flow installations and instrument specifications are readily available to shop personnel.

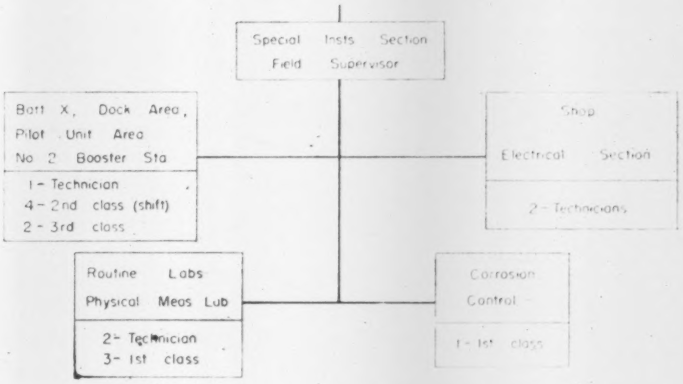
The Instrument Department should maintain its own shop under the same general supervision as the Field Instrument Crew. There should be no division of responsibility in the field for the operation of either the measuring instruments or the control valves. The two are as closely related in the control job as the "end" or primary measuring element. There can be no "buck passing" on a job where the instrument man is responsible for both the instrument and the throttling device. Most of us know of occasions where related pieces of mechanical equipment maintained by separate crafts have been the cause of prolonged arguments over which piece of equipment was not functioning properly. A good example of this is the reciprocating pump—which inhuman device is capable of creating plenty of misery for both the instrument man and the operator.

Instrument "ends" and control valves are the most delicate parts of any process which are exposed to operating conditions. I do not mean by this that the trim in a control valve or a thermocouple well is as delicate as, say, a galvanometer suspension or the linkage in a recording instrument. Nevertheless the control valve must be maintained in perfect alignment and must respond to the slightest changes from the control instrument. The thermo-


Zone - 1
Field Supervisors
Cracking Coils (10 units)
Flash Correctors (3)
Debutanizers (3)
1 - Technician
1 - 3rd class
Polymerization
H2 S Removal
Pipe Still No 1
1 - Technician
1 - 3rd class
L E F U - 13 Columns
C3 Caustic Wash
1 - Technician
1 - 3rd class
Alkylation - (5 Reactors)
Absorption - (6 Cols)
(2 stage rec)
LEFU Col 12
1 - Technician
1 - 3rd class
No 6 Boiler House
No 2 Water Treating Plt
No 2 Reservoir Pump Hse
No 2 Air Comp House
1 - Technician
Fluid Catalyst No 2
CLEU
GHB 2
1 - Technician
1 - 3rd class
2 - 1st class used where necessary
(i e construction, turnarounds)


Shop Supervisor
Machine Tools
(Wk Shop F'm'n)
Night Shift
(Wk Shop F'm'n)
Floor & Bench Section
Inst Tech
Electrical Section
(2 - Inst Tech)
Relief Valves
(Inst Rpm 1st)
Meter & Gage Section
(2 - Inst Rep 1st)
Control Valves & Regulators
Displacement Meters
Misc
LLC's other heavy items
Differential Inst
Gages
Inst Rpm 2nd
Clocks
Inst Rpm 3rd
Pilots & Misc small items


Engineering & Clerical
Supervisor
Zone 1 Process
SR - 10 Process
Flow Calc
Field Engineer
Zone 2 Process
Zone 3 Process
Inst Design
Field Engineer
Zone 4 Process
SR 43 Process
Laboratory
Field Engineer
Shop Design
Draftsman
Personnel Records
Files
Field Clerk
Relief Valve Record
Flow Records
Work Orders
Stenographic
2 Steno's
Material, Ordering, & Checking
Clerk
General Clerical
Time Keeping, etc
Clerk


Special Insts Section
Field Supervisor
Batt X, Dock Area,
Pilot Unit Area
No 2 Booster Sta
1 - Technician
4 - 2nd class (shift)
2 - 3rd class
Shop
Electrical Section
2 - Technicians
Routine Labs
Physical Meas Lab
2 - Technician
3 - 1st class
Corrosion Control
1 - 1st class

couple well must withstand the same operating temperature and pressure as the rest of the equipment, yet the walls must be thin enough to give rapid response to change in temperature. The control valve takes more punishment from corrosion and erosion because it takes the pressure drop in the system. Therefore, the "ends" and valves should have the same type of maintenance as the instruments themselves.

Our shop at Baytown serves the Baytown Refinery; Plancor 485, which is a butadiene Plant; and Plancor 1082, which is a butyl rubber plant. The combined departments total 164 men of which 52 are permanently assigned to the shop.

Major items of work recorded for the year of 1945 are as listed in Table II. This represents an appreciable volume of work, and I believe our shop is as large as any in the petroleum industry.

LOCATION OF SHOP

If the shop is to be organized as a complete and separate unit, it should be located at a point nearly central to the volume of work it is expected to handle. The greatest concentration of instruments in an area does not necessarily mean that this area will supply a proportionate amount of shop work. The amount of shop work from a plant area will be determined by severity of operating conditions due to pressure, temperature, corrosion, erosion, and frequency of downtime.

However, location central to the work is not controlling if adequate transportation is available. We are purchasing some "low boy" trailers with extra-large beds to be stationed at operating units during turn-arounds to serve as material platforms. These trailers will be pulled to the shop for use for incoming and outgoing storage. Considerable saving of time and handling expense is expected.

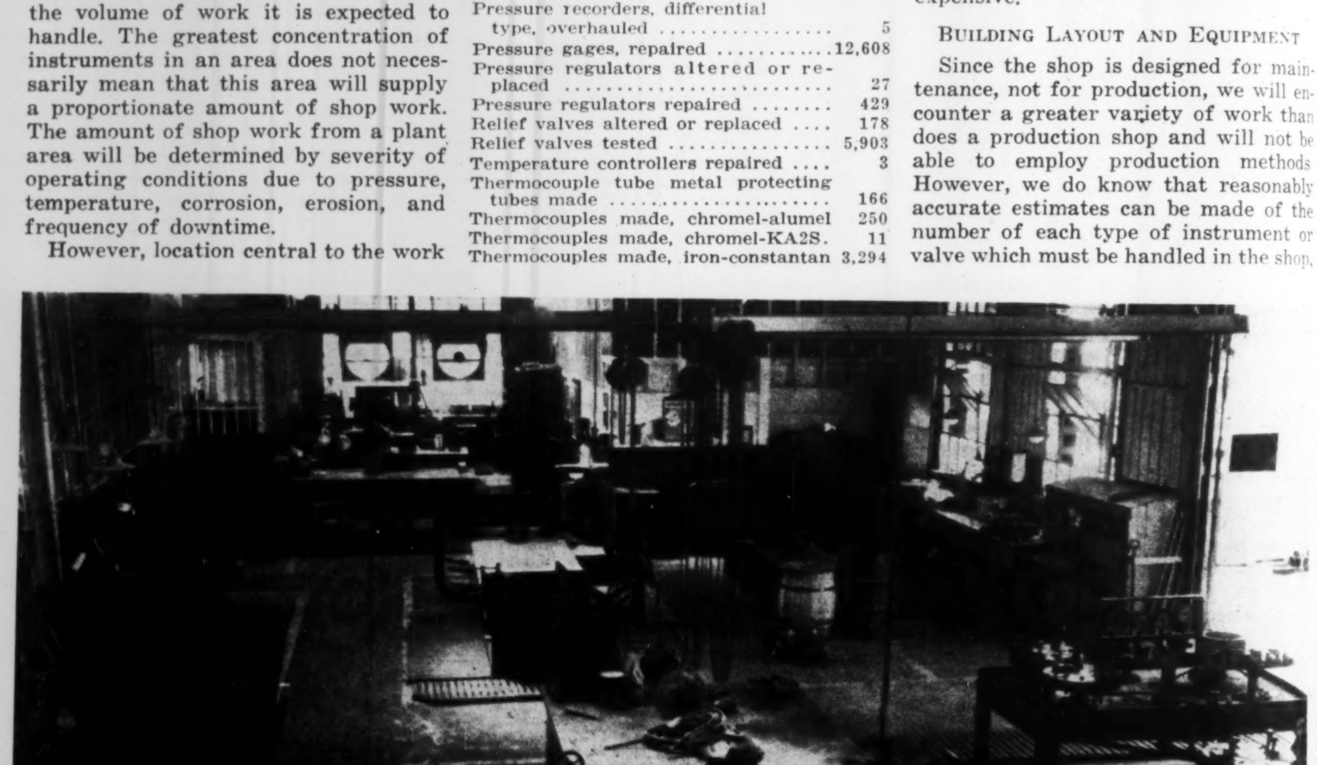
TABLE II—MAJOR WORK ITEMS IN 1945

Instrument clocks repaired	970
Control valves repaired	1,873
Control valves altered or replaced	78
Gage columns cleaned or repaired	1,509
Inspector's tube micrometers repaired	182
Conductivity cells replatinized and recalibrated	23
Counters repaired	234
Liquid level instruments, differential type, built	7
Liquid level instruments, differential type, repaired	68
Liquid level instruments, float type, built	9
Liquid level instruments, float type, repaired	161
Autosyn motors repaired	2
Other motors, overhauled	32
Manometers built (two types represented), total	108
Orifice meter manifolds built	88
Orifice meters overhauled	686
Orifice plates made, new	105
Orifice plates made, changes	229
Potentiometers overhauled and rebuilt	110
Potentiometers repaired	176
Pressure controllers built	1
Pressure controllers overhauled	27
Pressure controllers repaired	1
Pressure controllers, differential type, repaired	1
Pressure recorders, Bourdon type, overhauled	192
Pressure recorders, differential type, overhauled	5
Pressure gages, repaired	12,608
Pressure regulators altered or replaced	27
Pressure regulators repaired	429
Relief valves altered or replaced	178
Relief valves tested	5,903
Temperature controllers repaired	3
Thermocouple tube metal protecting tubes made	166
Thermocouples made, chromel-alumel	250
Thermocouples made, chromel-KA2S	11
Thermocouples made, iron-constantan	3,294

If the shop is not to be independent and completely equipped, it is my recommendation that it be located in or adjacent to the plant machine shop, even though some loss of authority over the work is suffered; however, a special machinist should be assigned for instrument work. In efficient shop work, especially the repair of control valves, bench work and machine work should be closely coördinated. Much time can be lost; expensive transportation costs and delays in returning equipment to service are caused by separating the benches from the machines. This separation will also result in increased spoilage of material—and instrument parts are very expensive.

BUILDING LAYOUT AND EQUIPMENT

Since the shop is designed for maintenance, not for production, we will encounter a greater variety of work than does a production shop and will not be able to employ production methods. However, we do know that reasonably accurate estimates can be made of the number of each type of instrument or valve which must be handled in the shop.



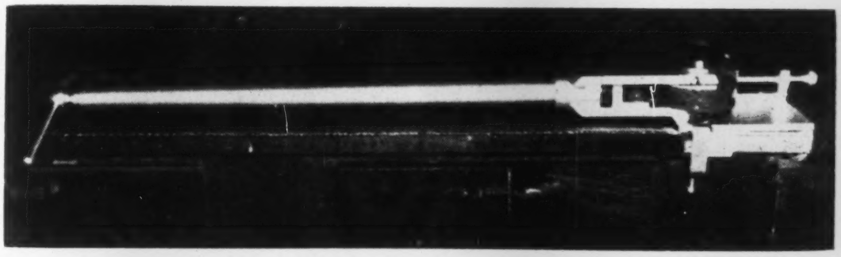
Relief Valve Section and Main Instrument Section and we can lay out our work space and equipment to best accommodate the work to be done.

Incoming material is received in a designated area. This area should be completely accessible by trolleys, jib cranes and small trucks, so that material may be identified and separated by the first instrument department employee to handle it.

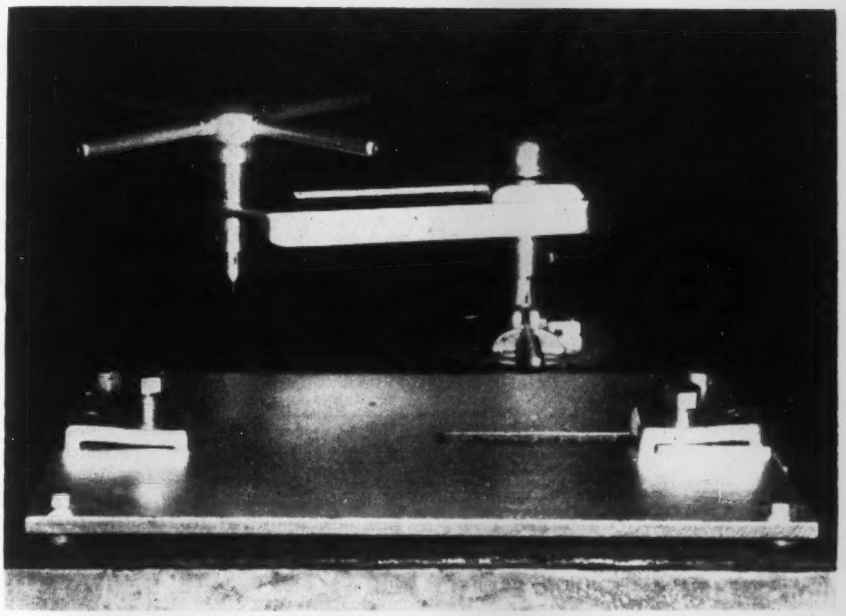
Identification should be made by permanent metal plates or tags which give either sufficient information on themselves or refer to specifications on file in the shop. It should be the responsibility of the field instrument men or supervisors to see that each item bears such an identification tag before it leaves the operating unit. In case this identification is lost, a temporary descriptive tag should be attached.

After identification and segregation of the various items, they should be cleaned before being brought into the shop. Some may contain corrosive and poisonous chemicals and safety demands that precautions should be taken in each case. At present, we use steam and hot water in cleaning instruments and valves before taking them into the shop. Some shops use vats containing alkaline solutions. During the war a number of automatic degreasers have been developed which are reputed to give excellent service. Care should be exercised in selecting the solvents, since it is not desirable to repaint everything that leaves the shop.

The working space in the shop should be divided into sections depending upon the number and types of items to be serviced. In this discussion, we will consider the shop which maintains all instruments, valves, and other devices pertaining to process control and, in addition, repairs and tests all relief valves, liquid level gage columns, inspector's measuring tools, and assumes various unrelated jobs when requested. The heavy work items, such as relief valves, large displacement meters, and large control valves, are allotted sufficient space nearest either the incoming area or the outgoing area. In our shop both areas are on the north side and the same opening in the building is used to bring in material or remove material. By keeping the heavy work near the opening, we avoid excessive handling with overhead cranes and the resultant congestion in the "in-and-out" area. Intermediate items may be handled at spaces more remote from the storage space, and the lighter items which are usually carried by hand may be assigned the more inaccessible spaces in the shop. The machine tool section should be partitioned from the bench and floor section. Likewise, the electrical work should be segregated, since there is little interdependence between these sections. The standards laboratory should be located adjacent to the office. The office, laboratory, and electrical sections should be air-conditioned.



Jig for forming tube metal thermocouple protecting sleeves.



Foot-operated screwdriver and clamp for pressure gages.

Proper illumination is essential. Accurate calibrations and fitting of parts cannot be accomplished in an inadequately lighted shop. It is possible to get adequate lighting of benches and machines but in the heavy-duty sections this is hindered by jib and overhead cranes.

All sections of the shop should be well ventilated, especially the manometer and orifice meter section, where the danger of spilled mercury exists. Forced draft should be employed where mercury vapors or chemical solvents are used.

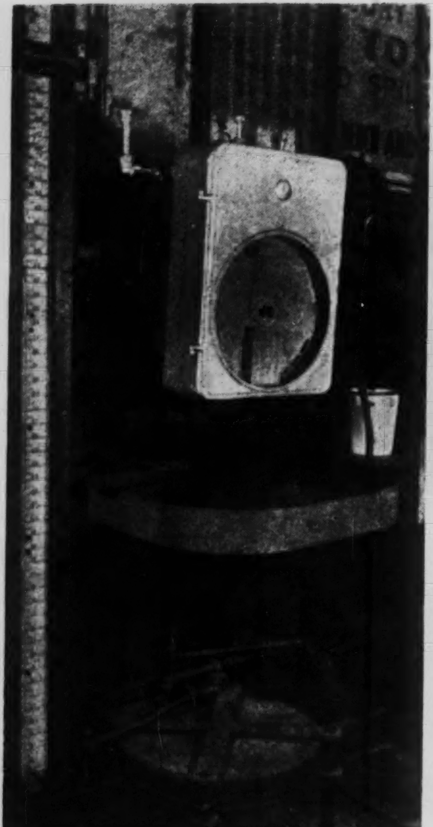
Due regard should be given to all aspects of safety in laying out the shop. This includes traffic aisles of sufficient widths for material and handling equipment, as well as for the traffic between the different sections. Working space around the benches should not be congested so that employees may get in each other's way and cause injury to one another from slippage or glancing blows, etc. Good housekeeping is difficult in crowded areas, and is made easier where sufficient storage space is provided. Where material must be piled under benches, stacked in corners, and shifted from spot to spot, the loss and breakage, the extra handling expense, increased safety hazards and other costs arising from such inefficiency and unsightliness will exceed the cost of the necessary space. Nothing should be stored under work benches. Of course, it may be necessary to have drawers in the benches for storing tools.

So much for housekeeping. We now consider equipment for servicing the various types of material.

Relief Valve Section

Although not serviced in many instrument shops, relief valves require more man-hours than any other type of equipment in our shop. As stated before, the testing equipment is located near the in-and-out passageway. We have three specially designed tables with heavy flanges slotted so that relief valves from 3″ to 6″ may be accommodated on each table. Special clamps are used instead of bolts, saving time in making pressure connections. Relief valves with screwed inlets (2″ and smaller) are mounted on a manifold on the table. Beneath the tables are air chambers made of 6″ double extra-heavy pipe.

Testing pressure is obtained by a motor-driven pump with capacity of 5 gpm. of water at 2500 lbs./in.^{2}. Water is used to displace air in the chamber, since 95% of all our valves must be tested with air. However, a compressor to deliver 5 cfm. at 500 lbs. is being installed. By using this compressor, we will save the time now necessary to blow down the water in the compression



Calibration stand for differential-pressure type flowmeters. Note catch basin for spilled mercury.

chamber. An increase in air capacity of about 600% is also indicated.

Pressure build-up for testing is controlled by by-passing a portion of the water from the pump discharge to the sewer.

Handling equipment over the relief valve tables consists of an overhead crane with chain hoist, and a jib crane equipped with a half-ton pneumatic hoist, and a pneumatic impact wrench which is retained by a balancer and will remain at any height. Pneumatic tools of this type should pay out in less than a year if used as much as five percent of the time.

It is customary to use air to blow off the seating surfaced after the compound has been washed off with kerosene or light oil. Eye injuries have been eliminated from this operation by using a stand with a foot-operated push valve and a lucite shield (similar to those used over grinding wheels) between the work and the employee's face.

Most of our valves are of the flat seat type and several sets of lapping blocks are used. It is accepted practice to lap with a block or jig of a metal with grain structure different from that of the material being finished (this same principle is used in seating pressure type shafts for differential meters). These blocks and the face plates used to restore them are consigned to separate sections of a bench. The sections of this bench and the blocks are painted in a color code to identify the abrasive used. We have learned that a lapping block used with coarse grinding compound becomes embedded with the carborundum and cannot be used in the final or polish step as it will scratch the surface of the seat or disk.

Specially-designed vise, built to hold melon type level controllers and displacement meters.

Lapping blocks for bevel-seat valves require more storage space and are kept in a cabinet mounted on casters. This cabinet is pulled up to the test rack when the lapping blocks or jigs are needed and is rolled into a storage space when not in use.

Each valve is marked with a "Company" number stencilled on the body, and with two metal tags attached to the bonnet. One of these tags gives the location, service, and setting of the relief valve; the other tag indicates set pressure and date of last test.

Complete records are kept showing initial installation, spring number, setting, indication of back pressure, as well as the relieving pressure at the beginning of each test. Since relief valves are installed and removed by pipe-fitters, the field men have little connection with them.

Main Instrument Section

This section is under the supervision of an Instrument Repairman First Class.

Differential meters should be given shop overhauls on an average of every twelve months depending, of course, on climatic and operating conditions. We would, under this schedule, overhaul about one hundred fifty meters per month; but the average runs less than half that figure, owing primarily to limitations in working space.

These instruments are dead-end when in service and are difficult to clean without dismantling. On the other hand, when the case is removed the pressure type shaft is exposed and may be damaged; therefore, they are usually cleaned as they are dismantled. Several types of mountings are available for attaching to permanent brackets on the work-bench. As in most refineries, the majority of our orifice meters are Metrics and use a mount which is permanently attached to the manometer body and held in place on a 2" pipe stand by two set screws. The same types of mounting are available for temporary storage of finished meters.

Painting facilities are inadequate at present but provision is being made for spray booths.

On reassembly, the meters are calibrated on stands above metal catch basins to catch spilled mercury. The calibrating manifold should be so connected that air of 200" of water pressure or vacuum to 5" or 6" of mercury is available. We use a small air jet with capacity tank of approximately 70 in.^{3} for vacuum checks. The use of vacuum enables the repairmen to calibrate manometers with "falling" floats and still leave the cover off the float chamber with adjustments accessible.

We use one manometer of 150" and one of 200", both of "single leg" design. The scales are made of lucite. A cold-cathode light behind the column illuminates the scale and water leg. Readings may be taken at ground level through a tank periscope, the movable prism of which is moved up and down by a pulley-and-drum arrangement.

In this section of the shop is also located a checking instrument against which all pneumatic controllers in the three plants are calibrated. With this instrument it is possible to transmit, receive, and control, by use of various capacities and lengths of tubing, behind the panel. We can adjust a pneumatic controller for throttling range and automatic-reset, simulating actual operating conditions.

Gas displacement meters are also repaired in this section. A two-foot prover is used in connection with this work.

The trend in our plant is toward the use of differential type level instruments. Each instrument is "tailor-made" and range tubes are built and mounted on the manometers to suit the liquid at operating conditions. Shop-made scales are installed on the manometers, calibrated in actual linear units or in percent of level. These instruments are built in the machine room and assembled and calibrated in the manometer section.

Housekeeping in this section of the shop should be stressed, particularly in view of the hazards from mercury vapors. The floor should be covered with linoleum or some smooth material and should drain to a catch basin. Forced-draft ventilation should be provided at least at breathing level of the employees.

A separate section of the shop is used for the repair of pressure gages, pressure recorders, instrument pilots, and miscellaneous jobs. However, the orifice meter work and pressure gage work is under the immediate supervision of an Instrument Repairman First Class.

Gages are usually cleaned externally before being brought into the shop. Those removed from chemical service or which have been used on tar or other heavy oil are evacuated in a special contraption which is lined with steam coils to melt out solidified material.

Some shops use a pulsating device to wash the gage tubes with a solvent.

Most plant gages are calibrated against test gages which in turn are calibrated daily on dead-weight testers. (These testers should be in the testing lab and in the charge of a responsible man. We had an instance where the plunger became damaged on a dead-weight tester and one of the helpers had the cylinder bored out by one of our machine operators. Fortunately, this mistake was noticed before any gages had left the shop.)

A vacuum pump is necessary for checking vacuum gages for they are usually checked against mercury manometers. A mercury manometer is also used in checking low-range pressure gages.

Several jigs and special tools have been devised by our shop personnel to start-up and facilitate the work. One of these is a foot-power screwdriver for removing tube assemblies. This device is instantly adjusted to any height. Another gadget is an adjusted spanner wrench for removing face rings.

Pressure gages are repaired and calibrated on a bench which handles four test pumps. Two of these test pumps are of the type furnished by gage manufacturers. The other two have the cylinder below the table and the test and work gages mounted on stands at eye level. The hand wheel is horizontal with its center about three inches above the table top. This arrangement provides more working space on the table and a different arm movement is applied pressure to the cylinder. It is not preferred by all of the men working on gages but does afford a change.

This section also builds special manometers using plastic tubing or glass. If these manometers are to be used for liquid level measurements with bubblers, we manufacture scales calibrated in linear height of liquid being measured.

Special dials are manufactured to indicate the output of pneumatic transmitters. These dials or scales may be calibrated in the same units as the transmitter.

Pressure recorders are calibrated in the same manner as gages.

Instrument pilots are also checked and repaired in this section. Jigs are provided such that the pilots may be mounted and adjusted to simulate actual operating conditions.

Registers or counters for displacement meters are also repaired in this section.

Both metal and wooden cabinets are provided for storage of supplies and parts. We find it advisable to keep the spare parts supply in the shop at an absolute minimum.

The more common instruments are shown on photographs and "exploded" drawings. These charts are on the walls near where the work is being done.

Control Valve Section

This section is allotted a relatively large working space, due to the variety and volume of work. Items serviced include control valves, float type levels, liquid displacement meters, gage columns, pump governors, and all the larger jobs not handled in the manometer section.

Valves range in size from ½" through 20". Flanged valves up to 4" are mounted on a special holding device which is fastened to the work-bench. This device consists of a split sleeve, to which is adapted a series of shafts, fitted with flanges to match the valve flanges. The shaft is notched and grooved to permit rotation of the valve through 360° in 90° steps, with safety catches to prevent valves being accidentally dropped. The shaft is drilled through and tapped for an air connection so that the valve may be tested during the grinding-in operation without reassembling.

Work on screwed valves is done by either holding in an ordinary machinist's vise or on the bench top.

Work on valves 4" and larger is done on the shop floor.

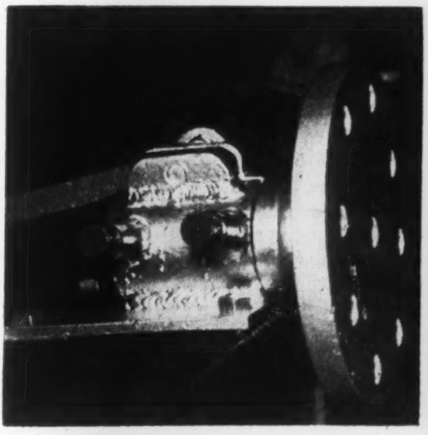
A complete set of shop-made tools is available for removing or replacing seat rings.

We also have a set of jigs for positioning broken spring barrels and valve yokes for welding. We have found these holding devices absolutely essential to get perfect alignment of the valve.

Very little time is spent in grinding the seating surfaces. We have found that it is easier to reface on a lathe.

This section of the shop has several pneumatic nut runners and impact wrenches which speed up the work, especially when it is necessary to remove a diaphragm cover plate.

After assembly, each valve is checked for stem travel, initial opening pressure on diaphragm, and full opening pressure.



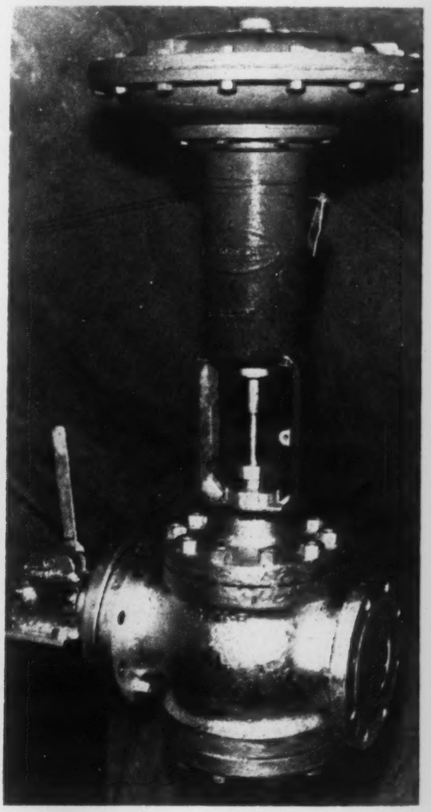
Holding device for flanged valves.

Wall charts are used to indicate the travel of the various sizes of valve plugs. Other charts are used for reference in selection of packing and lubricant for each service.

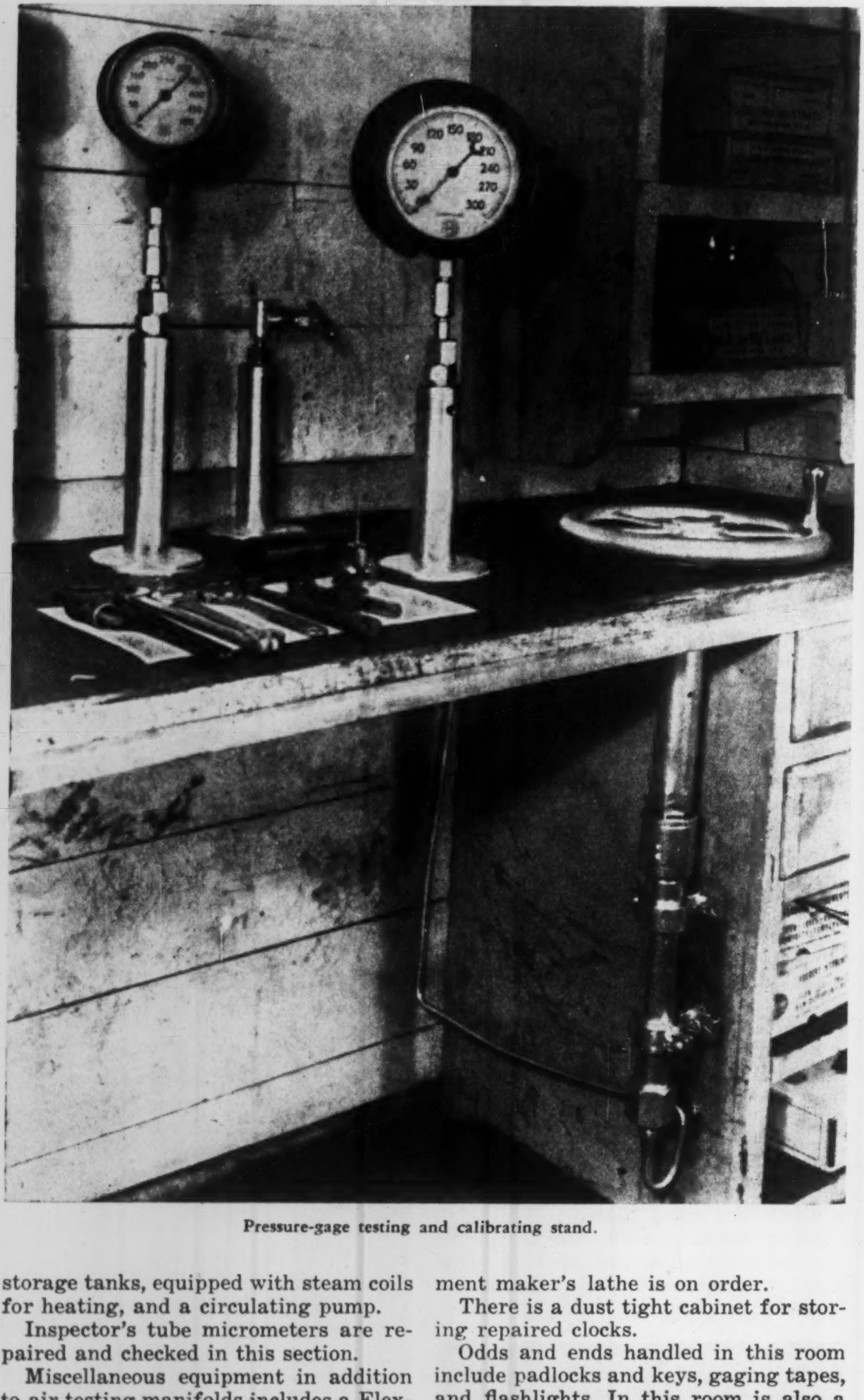
As will be noted in Table II on shop work, quite a few valves are manufactured in the shop in the course of a year. This is especially true when a pilot unit is being built or revised. In other cases, control valves are altered to fit certain conditions. As an example, a hydraulic actuator was designed, built, and installed on a 6" three-way valve within an elapsed time of thirty-six hours. We have a special differential pressure regulator for holding seal on pump glands. About fifteen of these were built within a period of two months.

A special vise has been constructed to hold melon type level controllers and displacement meters. Displacement meters are calibrated on a shop built rack with adapters which will accommodate meters from ¾" to 3". Connections are made pressure-tight by adjustment of a hand-wheel which moves the outlet pipe. The meters are calibrated with water which is discharged into a tank and weighed. Three calibration runs are made, each at a different rate, as indicated on an orifice meter.

For several years we cleaned gage columns by dismantling them. This resulted in considerable breakage of glasses. We are now able to clean about 90% of our gage columns by circulating solvents through them. This cleaning equipment consists of three solvent



Holding device for flanged valves, in use.



Pressure-gage testing and calibrating stand.

storage tanks, equipped with steam coils for heating, and a circulating pump.

Inspector's tube micrometers are repaired and checked in this section.

Miscellaneous equipment in addition to air testing manifolds includes a Flexdrive unit with burring, reaming, and buffing attachments; a spring tester, a jig for forming tube metal thermocouple protecting sleeves, and a 60-ton hollow plunger jack for pulling butterfly valve shafts.

This area is covered by two cranes.

Clock Room

The clock room is quite small and is sealed. It is equipped with forced draft ventilation because of the confined area and because of the various solvents used in cleaning parts. A L & R parts washing machine is used. Some watch making equipment is provided and instrument maker's lathe is on order.

There is a dust tight cabinet for storing repaired clocks.

Odds and ends handled in this room include padlocks and keys, gaging tapes, and flashlights. In this room is also a stenciling machine used to make metal nameplates and identification tags.

Tool Room

A section of the Shop Supervisor's office is partitioned off for a tool room. The tool room man cuts all gaskets and diaphragms, and keeps the shop supply of packing and lubricants. He also cuts glass for gages and instrument doors. This tool room also serves the Field Instrument Men when special tools are required. Tools peculiar to the machine section are not kept in this room at the present time. Much improvement is possible in this system.

pH Control

A small cabinet and bench are located in another section of the Shop Supervisor's office; in this are kept the pH comparators and indicators as well as ammonia meter parts and chemicals used in pH and chlorine determinations. This work will be done in the lab room when our expansion program is complete.

Machine Room

We maintain quite a complete array of machine tools and do all machine work in connection with instrument repairs except work that is too large for our machines to handle.

This section is under the supervision of a working shop foreman and operates two shifts—sometimes three shifts. Machines now installed include three lathes—one 20″; one 14″; and one 10″; a No. 2 Universal mill; a 21″ drill press; a power hack saw; and a pantograph. Miscellaneous power tools in addition to grinding wheels include a small high-speed drill, a diamond cutting saw, and a tool grinder for the pantograph. Another 14″ lathe, an instrument maker's lathe, and a small mill are on order.

It is evident that we are equipped to make almost any part we need. Examples include flow nozzles up to 16″, all sizes of valve trim, thermowells, etc. We have a complete set of jigs for seat rings as well as numerous shop-made attachments for holding and lining up machine work.

The pantograph is used to make scales and name plates. By use of a device developed by one of our engineers, we can fabricate a flow nozzle template in a few minutes.

Many special pieces of apparatus are built for the lab; examples include a variable-wave-length cell for the infrared machine, a lamp and lens holder for the ultraviolet machine, rotameter floats, etc.

In 1945 we designed and built two liquid gravity recorders, fourteen bronze venturi tubes, one level indicator for −50°F. Gear trains were made to transmit this measurement through Autosyn motors. Other jobs include a pipe layout tool, micrometer depth gages, and two pressure recorder-controllers with a range of −1″ to +1″ of water.

Acetylene welding equipment is kept in this section. Our welding is confined to structural work, no pressure-tight welding is permitted. Jobs include fusing thermocouples, orifice plate handles, and repairs to instrument parts.

Electrical Section

The primary function of the Electrical Section is repairing and calibration of potentiometers. However, many odd electrical jobs are handled.

Equipment includes the usual millivolt potentiometers ranging from 0 to 50 and 0 to 111mv; three Wheatstone bridge circuit testers; a Weston No.

785 Industrial circuit tester; three voltmeters; a decade resistance box; and a d'Arsonval galvanometer.

There are also two thermocouple checking furnaces. Electronic testing equipment is being added from time to time but most of these instruments are kept in the Maintenance Section of the plant laboratory where they are used on the mass spectrometer, infrared, ultraviolet and similar instruments. There is also an Allen magnetizer for restoring instrument magnets.

The men in this section overhaul or rebuild potentiometers and resistance thermometers. They can wind coils and change slide wires to any range desired.

Assignments in this section are rotated semi-annually among the technician group, which is the highest classification below supervision.

Although not directly connected with the shop program, the men in the Special Instrument Section are under the same supervision as the shop men on pyrometer work. The special instrument section is composed of men specially selected for assignment to laboratory instrument. A background of experience and education in electronics is required. Many of the instruments now being studied in the laboratory will be used in plant operations in the not-too-distant future. In fact, both the infrared and ultraviolet spectrometers are used in process work today. By working with the laboratory group during the development of these instruments, we are better prepared to service them in the plant. Our men also have lent some assistance in research and in the development and modification of these instruments.

Miscellaneous Equipment

Field checking instruments available in our shop include 2 portable gas balances; a 100" water manometer; an aneroid barometer; a portable draft gage; 2 Orsats; an absolute pressure gage; an optical pyrometer; two potentiometers calibrated in degrees and another calibrated in millivolts; a circuit tester; a pH indicator; and a wide-range conductivity indicator. Four precision rotameters are available for testing small orifices and flow nozzles where data are not available for calculating coefficients.

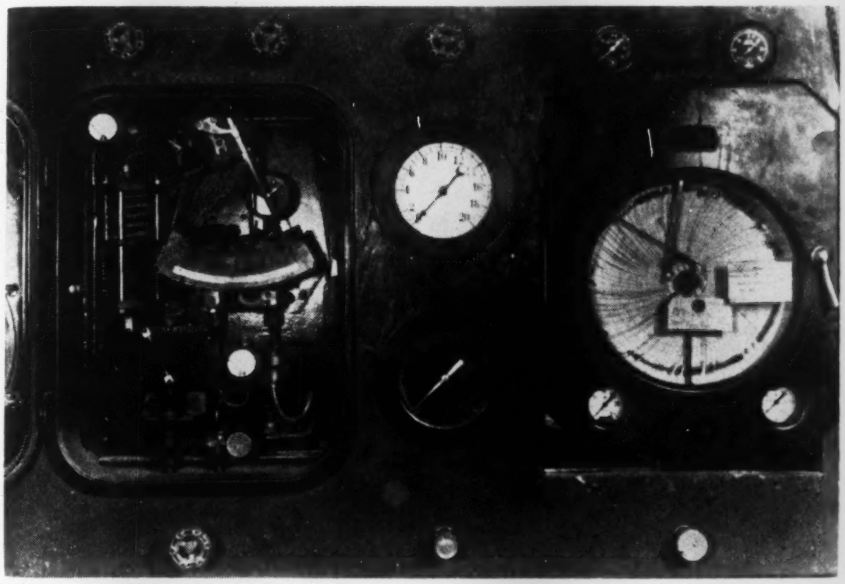
FIELD DISCUSSION

Since at the beginning we decided to build our organization around the field, it should be in line to discuss the field organization and some of the tricks and gadgets employed in this work.

Immediate supervision of field instrument work is assigned to Instrument Technicians; this classification was developed from the old "pyrometer man" after we abandoned specialization. The Technician may be assigned one or more operating units, depending upon the number, type, and service requirements of instruments in his area. He is assisted by lower rated men, some of whom are on permanent assignment. The Technician is responsible for installation, maintenance, repair and operation of all instruments in his area, regardless of type. Where special instruments are used he may, of course, require assistance from other members of the Department. We have nineteen field zones or technician assignments in the Refinery and six in the two rubber plants.

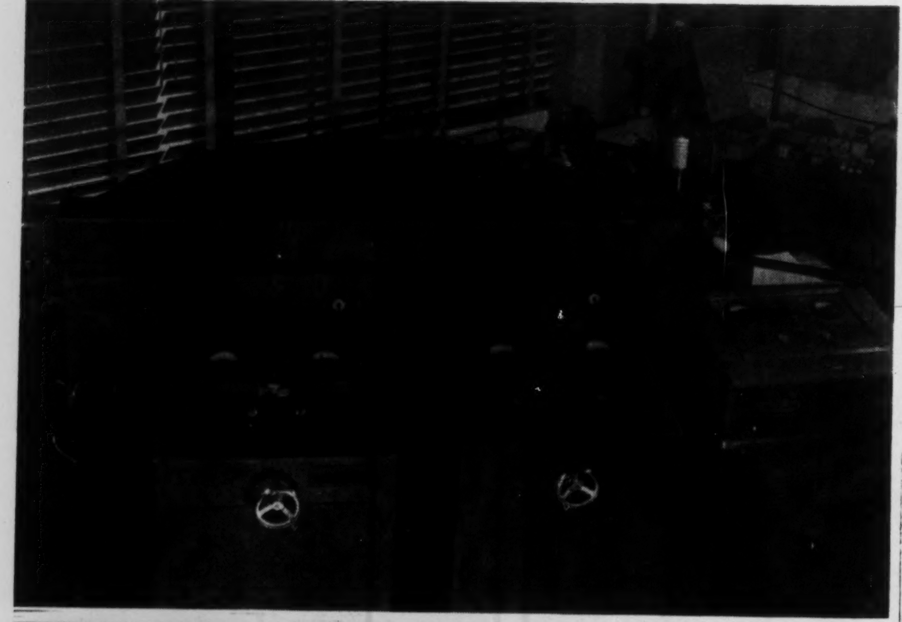
During construction a Technician is assigned well in advance of completion of a new plant. He tabulates all flow data, locates all points of measurement and all points of control; and makes a thorough check of each installation. Before the unit is put on stream, he prepares the instruments for operation. He assists the operators in bringing the unit on stream and keeps records of changes which should be made at any down time.

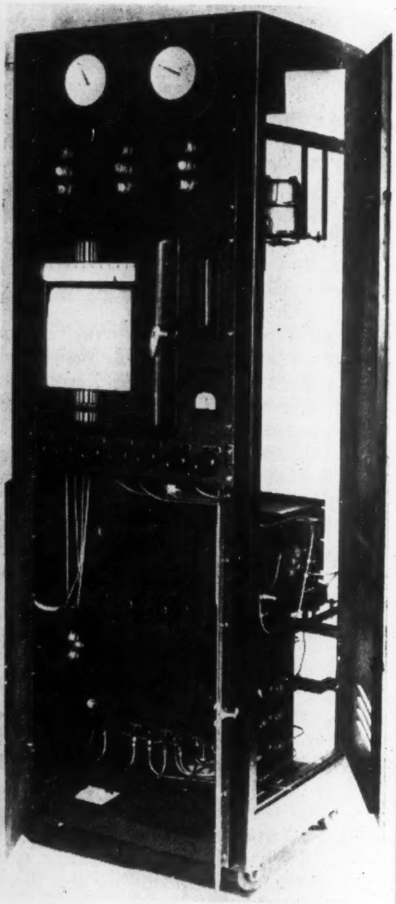
Preparation for operation includes checking calibration of transmitters and receivers, putting in mercury, checking thermocouples for location and polarity, checking valve action, testing and adjusting alarms and signals, testing for leaks in transmission and control lines, and other routine servicing with which all instrument men are familiar. For sealing pressure gages and meter leads, we use a pot or seal chamber mounted on wheels. Checking of transmission lines and thermocouple leads is facilitated by use of magnetic monophone or telephone sets. Where we do a major construction or replacement job ourselves and must run a lot of tubing we use a small air hoist to stretch the tubing, layout it in a trough to keep it straight. Recently we adopted the use of pipe instead of racks to support tubing runs.

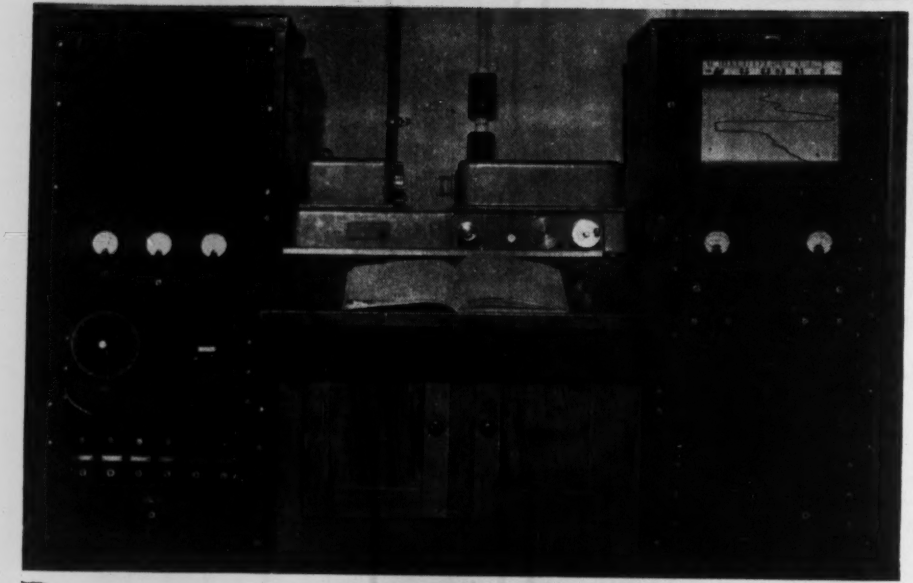


Test and calibration panel for checking all the air-operated automatic controllers in the three plants.

Outdoor receiving and shipping area for large valves and pressure regulators.







Spectroscopy in the Petroleum Industry

Some of the instruments in the Esso Research Laboratory, Elizabeth, N. J.

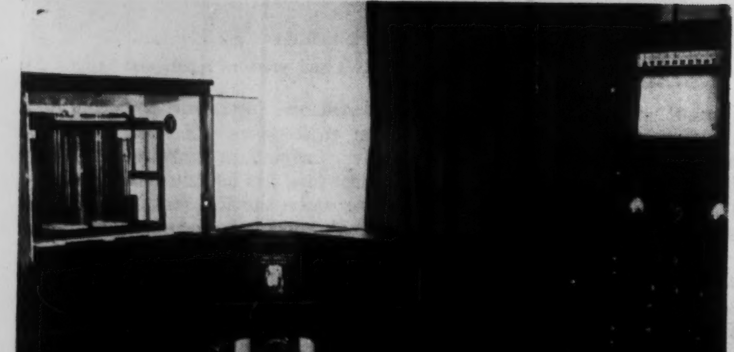
Top left—Grating Emission Spectrograph.

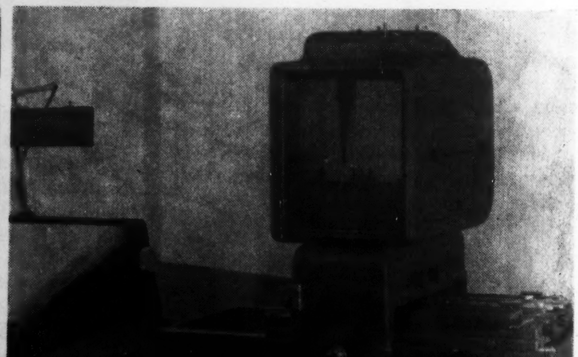
Top right—Continuous Infrared Gas Analyzer for plant application.

Center—Recording Infrared Spectrograph of recent design.

Lower left—Recording Raman Spectrograph (experimental).

Lower right—Microphotometer for examination of spectra.





Scientific Glass Blowing and Laboratory Techniques

By **WILLIAM E. BARR** and **VICTOR J. ANHORN**, Gulf Research & Development Company

XI. HIGH-VACUUM TECHNIQUE IN EQUIPMENT PRODUCTION *(Cont'd)*

The Static Vacuum System in Equipment Production

Vacuum-jacketed vessels and columns are used extensively in scientific research. On many occasions when such special equipment cannot be purchased, the glass blower is asked to make parts or the entire assembly. For the sake of review and also to point out additional fabricating techniques, and production, silvering, degassing and evacuation of vacuum-jacketed flasks and columns will be discussed.

Vacuum-jacketed flasks, commonly called Dewar flasks after their inventor, are useful for storing refrigerants such as liquid nitrogen or a dry-ice-trichloroethylene mixture. To minimize evaporation loss a double-jacket arrangement is used, Fig. 142C. The annular space between the inner and outer walls is evacuated after the walls are silvered. Such flasks can be made in various forms, the most common of which are the narrow-mouth and wide-mouth flasks. The steps involved for making these flasks are illustrated in Figs. 142A and 142B. The inner jacket is formed and the glass at the open end is spun into a flare which fits snugly into the outer jacket. The inner jacket is then centered in the outer jacket with two pads of fiber-glass ribbon. Streamers from these pads are required for their removal after the flare seal is completed. The assembly is then mounted as shown in Fig. 142B and the outer jacket is drawn down until the opening in the glass is about 10 mm. The excess glass is cut away in the burner flame and a 10-mm. tube is sealed to this opening. The tube is constricted in the burner flame until the opening is about 2 mm. and the wall thickness at the construction is twice the original wall thickness.

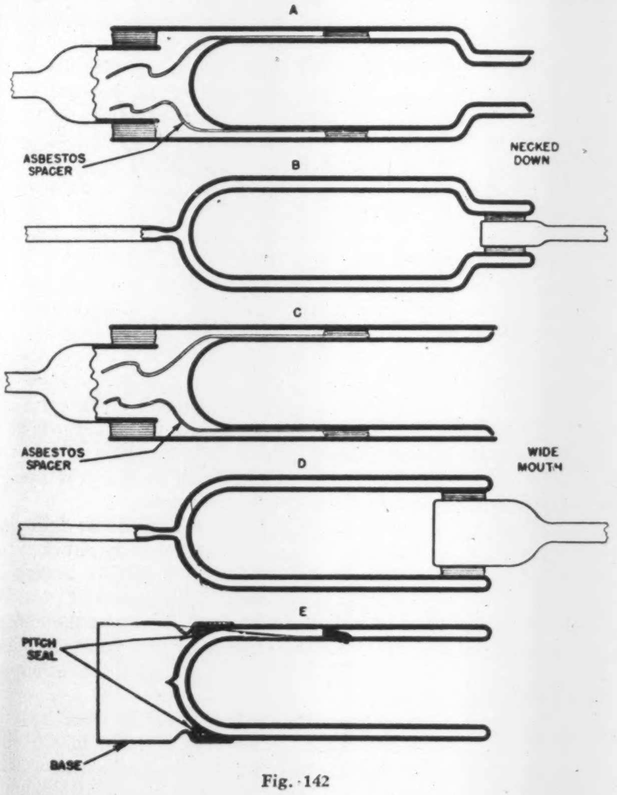


Fig. 142

When Dewars are to be strip-silvered, two tubulations are required instead of the one, Fig. 148B. These tubulations are sealed to the bottom about one-half the distance from the center line of the Dewar and the outside wall. The center tube is then removed. The flask in the open furnace, Fig. 140, was constructed in this manner.

Distillation heads for low-temperature distillation columns are built on the principle of the Dewar flask. The cooling head of a low-temperature distillation column is shown in Fig. 143B. The inner jacket is formed and a flare is spun on both ends. These flares should fit snugly into the outer jacket. The outer jacket, to which is sealed the tubulation, and the inner jacket are mounted on holders as illustrated in Fig. 143A. The holder for the inner jacket should be a tube of vitreous silica which will not soften when the large flare seal is made. A blow tube is connected to the holder on the opposite end. The large flare seal is completed by fusing the glass, blowing it out and tooling it down with a carbon tool. The blow tube is then connected to the tubulation and the small flare seal is completed. Both seals are carefully annealed as soon as they are made.

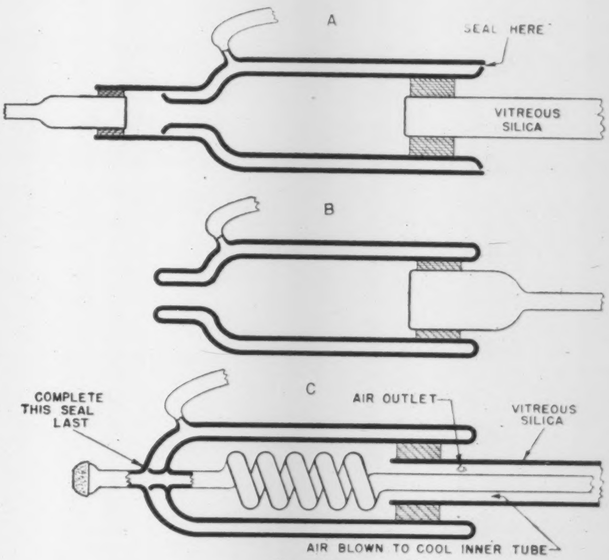


Fig. 143

A special condenser with a vacuum jacket is illustrated in Fig. 143C. The inner jacket is formed and a flare is spun on the open end. The outer jacket is made and a tube is sealed to the side. The spiral is sealed into the inner jacket and a short extension is immediately sealed to the ring seal. This extension is then flared. The outer jacket is slipped over the inner jacket and the entire assembly is mounted on a vitreous silica tube which has a small hole behind the asbestos tape. As the flare seal is made, air is blown through the vitreous silica tube to keep the extension tube of the spiral from becoming too hot. The spherical joint is ring-sealed to the bottom of the jacket assembly. All seals should be annealed as soon as they are completed.

When large Dewars are needed with an outlet at the bottom, it has been found advantageous to insert a spiral between the inner and outer jackets. The contraction caused by the temperature differential when the refrigerant is poured into the flask is absorbed by the spiral. The flare seal is made first and the spiral is then ring-sealed to the outer jacket.

In all glass jacketed columns, two tubulations are required on opposite sides if the jackets are to be strip-silvered.

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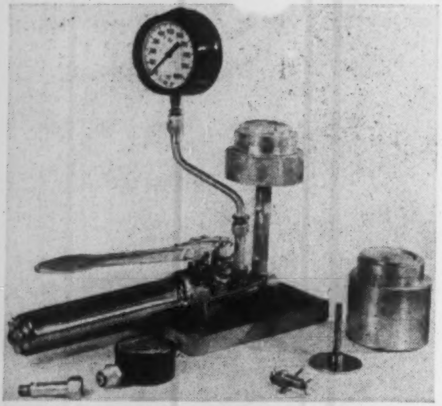

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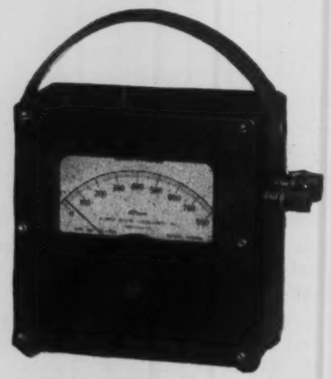

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Vacuum Jacketed Columns

Silvered vacuum-jacketed distillation columns must have some provision for the longitudinal expansion or contraction on the inner or outer tubes, because of the thermal efficiency of this type of insulation. There are various ways to prevent expansion breakage. The first is to match the expansion of the inner and outer tubes by using a vitreous silica tube which has a very low coefficient of expansion for the inner tube and Pyrex brand glass No. 744 for the outer jacket. This practice was recommended by Podbielniak.[12] A second method of matching expansions, especially in the temperature range 50 to 300°C., is to maintain temperature on the outer jacket so that the gradient across the two tubes is of the order of about 5°C. This is accomplished by using an electric heater on the outer jacket. Operation of the distillation column is thus complicated by temperature control. A third way of overcoming the disastrous effects of unequal expansion is to provide a flexible glass section in either the inner or outer tube. Glass tube spirals have been used successfully on the inner tube. These spirals are sufficiently flexible to absorb the unequal expansion but offer the disadvantage of increasing the length of the column. Instead of spirals for the flexible tube section, it has been shown by D. J. Pompeo and E. Meyer[13] that flexible glass bellows on the outside tube can be used with a great deal of success.

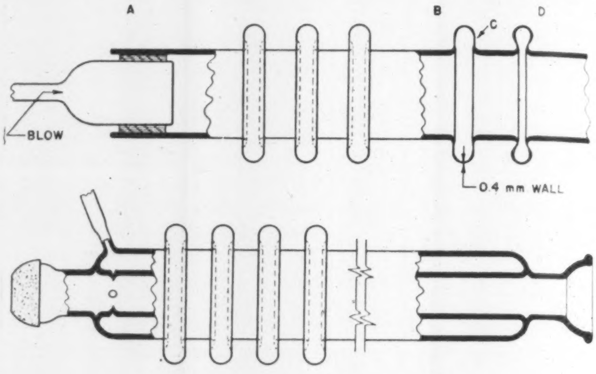


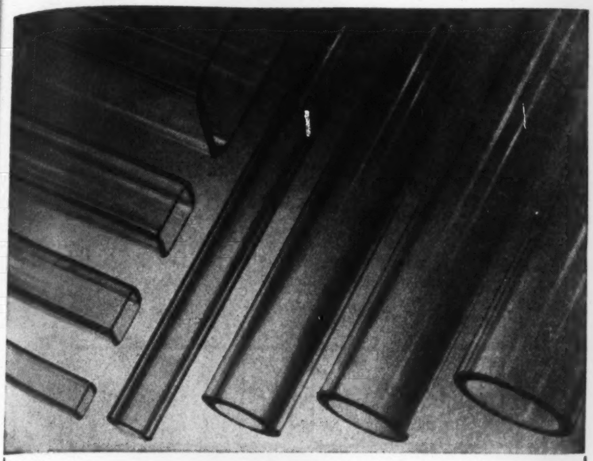
Fig. 144

A glass-blowing lathe is required for the construction of glass bellows because the tube must be held perfectly centered. Since a short section of the glass is fused for each convolution, it is obvious that uniform wall thickness, which is essential in bellows construction, cannot be obtained in hand work. There are two forms of bellows. If the annular space between the inner and outer tubes of the column is about ¼″ the outside bellows must be used. This form of bellows has the disadvantage of extending out from the tube. The thin glass of the bellows is exposed and can be broken quite easily. However, guards can be made if necessary. The second form is the inside bellows.

Convolutions for the outside bellows are made as follows:

1. A section of tubing 51 mm. in diameter is chucked in the lathe. Several layers of asbestos tape should be wrapped around the tubing before it is chucked. This tape will prevent breakage if the tube is not entirely true, because the chuck tension is localized to about 1″ length of the tube. A blow tube is connected to one end of the tube and the other is closed with a stopper.

2. A 2-cm. circular section of the tube is then heated while the tube is in rotation. The glass is then blown out slowly after the flame is removed and the tailstock of the lathe is moved so that the glass has the shape illustrated at B in Fig. 144. The glass is then allowed to cool for about four seconds and the blown section is pushed together until the shape illustrated at D in Fig. 144 is obtained. It is possible to form the glass in this manner because the glass at point C, Fig. 144, retains heat longer since it is thicker and closer to the tube than the glass at the periphery of the bellows. Properly-made bellows require precision timed move-



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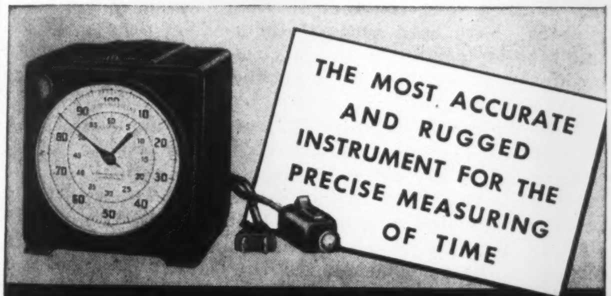
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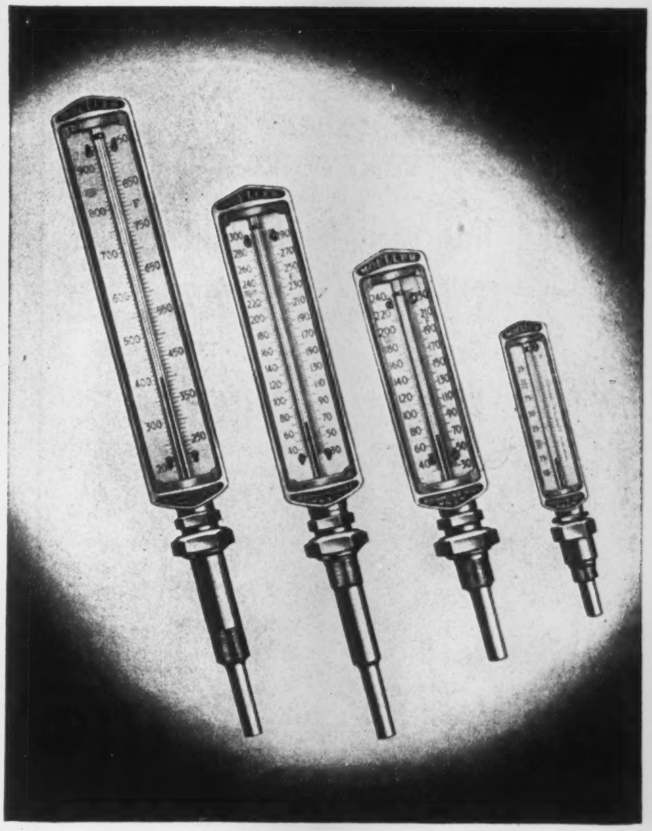

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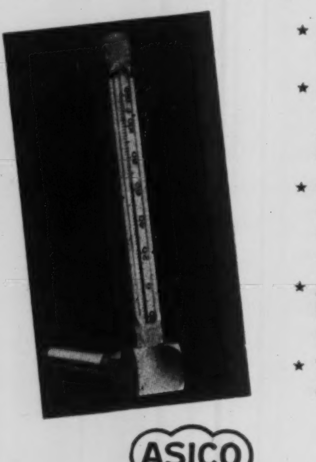

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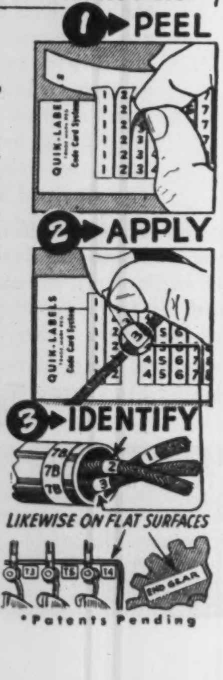

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ment in their formation with due regard to control of the viscous glass.

It has been found that the wall thickness of the bellows at the periphery should be about 0.4 mm. for best results.

3. Additional bellows are made by moving the burner 20 mm. from the first and repeating the above operation.

4. The entire assembly should then be carefully annealed.

Convolutions for an inside bellows are made as follows:

1. The glass tube, 51 mm. in diameter, is chucked in the lathe as described above. The blow tube is not required.

2. A 10-mm. circular section of the tube is evenly heated and stretched to 20 mm. as shown at A in Fig. 145. This thin section is then tooled down with a 6-mm. carbon rod to a depth of 10 mm. as shown at B, Fig. 145. The shoulder at B is then heated with a Hoke hand torch and the tailstock is moved 5 mm. toward the head chuck. The shoulder on the other side of the convolution is then heated and the tailstock is moved 5 mm., completing the convolution as shown at D, Fig. 145.

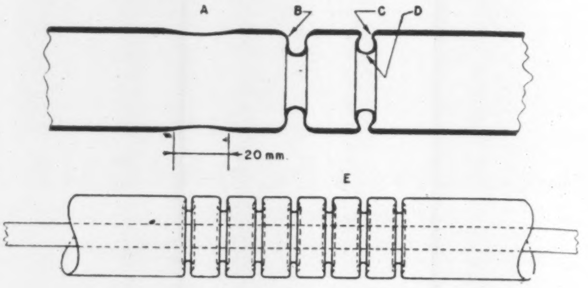

Fig. 145

3. Additional convolutions of the bellows are made as above with 20 mm. between each. The entire bellows is then carefully annealed.

It has been found that five convolutions are sufficient for columns 18″ long when inner tube temperatures up to 350°C. were obtained. For columns 48″ long, seven convolutions, Fig. 145E, have been successfully used on columns where inside tube temperatures of 300°C. were used. In both cases the difference in temperature between the inner and outer tubes was about 200°C.

The production of bellows requires a technique which can only be gained through experience. The most important thing to remember is that the wall thickness of original tube and of formed convolutions should be uniform. The wall thickness of the convolution at C, Fig. 145 should be 0.4 mm. with a gradual increase to 0.8 for the glass at the shoulder C. The size of the convolutions for the bellows need not vary much with different tubing sizes except when certain convolution depths are required.

Long column sections are sometimes required in distillation problems. The production of jackets, of the order of 120″, is possible but equipment of this size becomes quite cumbersome. Jackets with overlapping sections, Fig. 146, are convenient. A thin layer of asbestos tape in the lapped section prevents glass-to-glass contact and yet allows for a certain amount of flexibility. Each section of the jacket can be made with bellows so that the expansion is compensated in that section.

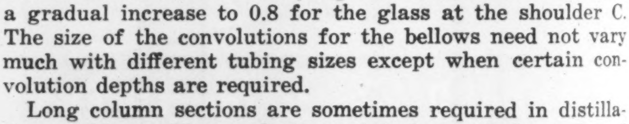

Fig. 146

Silvering Vacuum Flasks and Jackets

Silver-plating the walls of vacuum-jacketed glass equipment increases their heat-insulating properties greatly—in some cases enormously. R. B. Scott, J. W. Cook and F. G. Brickwedde[14] studied techniques for silvering Pyrex brand

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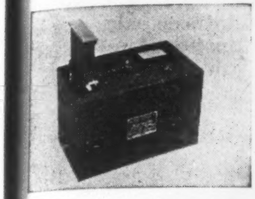

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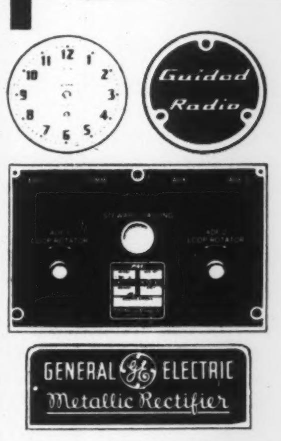

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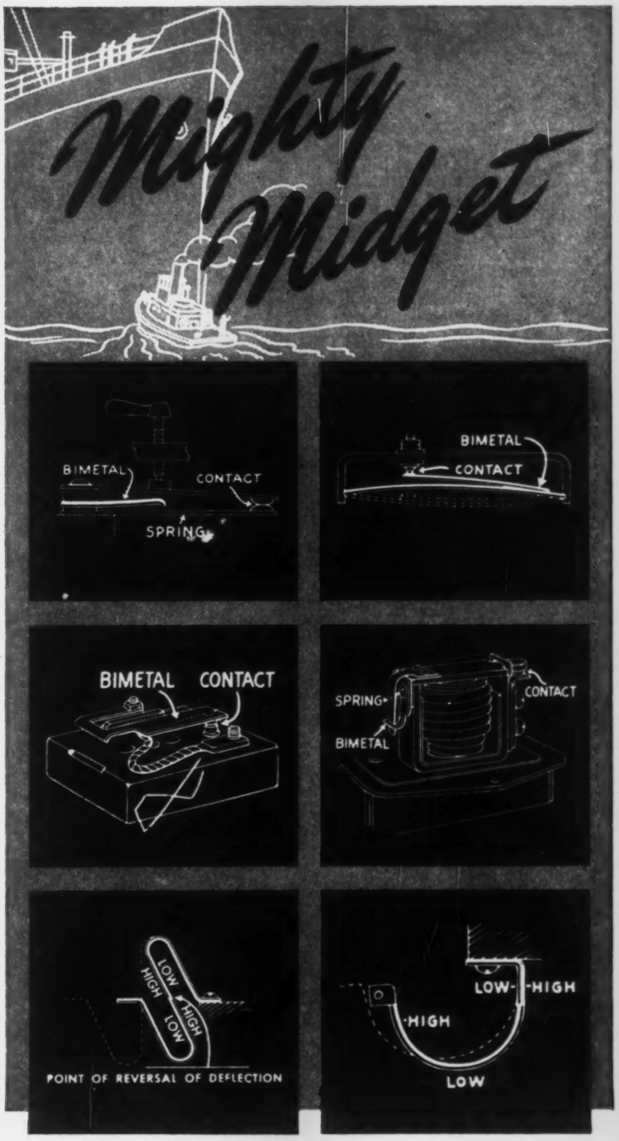

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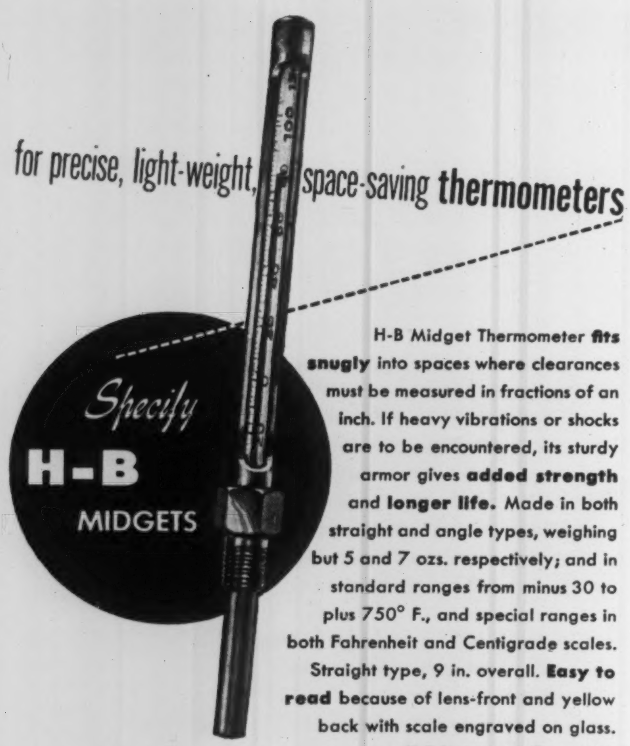

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glass No. 774 and found that equipment made of this glass could be successfully plated by adjusting the proportions and reagents of the Brashear formula. Their formula has been used successfully in this laboratory and for convenience will be outlined from their work.

Means of Introducing and Removing Cleaning and Silvering Solutions. In all equipment which is to be silvered, some provision must be made for introducing silvering solutions. Since such equipment generally is also evacuated, the opening for introducing the silvering solution can also serve as a tubulation through which the jacket is evacuated. It has been pointed out before that the tubulation must have a constriction near the vessel in order that it can be properly tipped off. This constriction will cause some difficulty when introducing cleaning and silvering solutions unless some special expedient is used. The system illustrated in Fig. 147 is very convenient for adding and removing liquid from a jacketed vessel. The three-way stopcock is clamped to a rigid stand. Vacuum on the suction flask is supplied by a pump or house vacuum. The jacket can be evacuated by turning the stopcock connecting lines A and B, Fig. 147. The solution can then be added by filling the funnel and turning the stopcock until lines C and B are connected. Solutions can be removed by turning the stopcock connecting lines B and A.

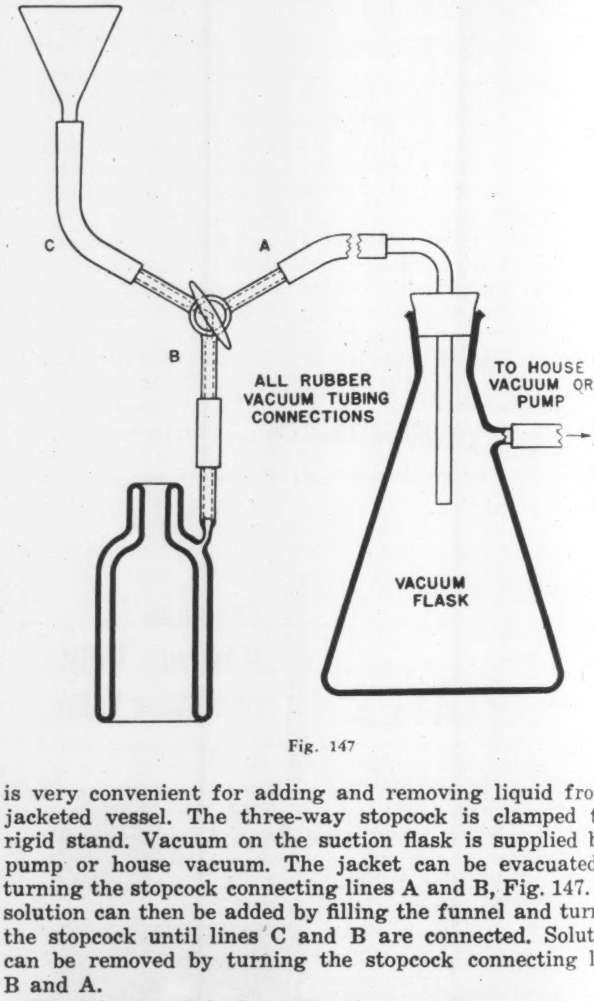

Fig. 147

The Silvering Solutions. The three solutions required for silvering glass equipment are prepared as follows:

1. Fifty grams of silver nitrate ($AgNO_3$) are dissolved in two liters of distilled water. This solution should be stored in a clean bottle and kept in a dark place.

2. Ninety grams of potassium hydroxide (KOH) are dissolved in two liters of distilled water. This solution is also stored in a clean bottle. No storing precautions are necessary except that the bottle should be kept stoppered when not in use. The solution improves with age.

3. Eighty grams of cane sugar are dissolved in 800 ml. of distilled water. A solution of 3.5 ml. of nitric acid (HNO_3) with a specific gravity of 1.42, in 100 ml. of ethanol (C_2H_5OH) is added to the sugar solution.

The silvering solution consists of 16 volumes solution 1, 8 volumes solution 2 and 1 volume solution 3.

Cleaning Equipment Prior to Silvering. Glass equipment which is to be silvered should be carefully cleaned. The

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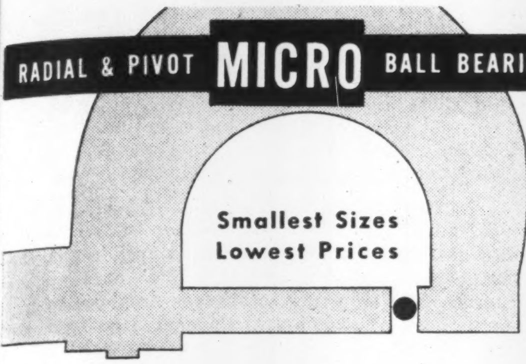

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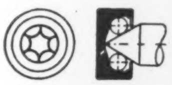

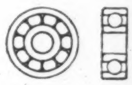

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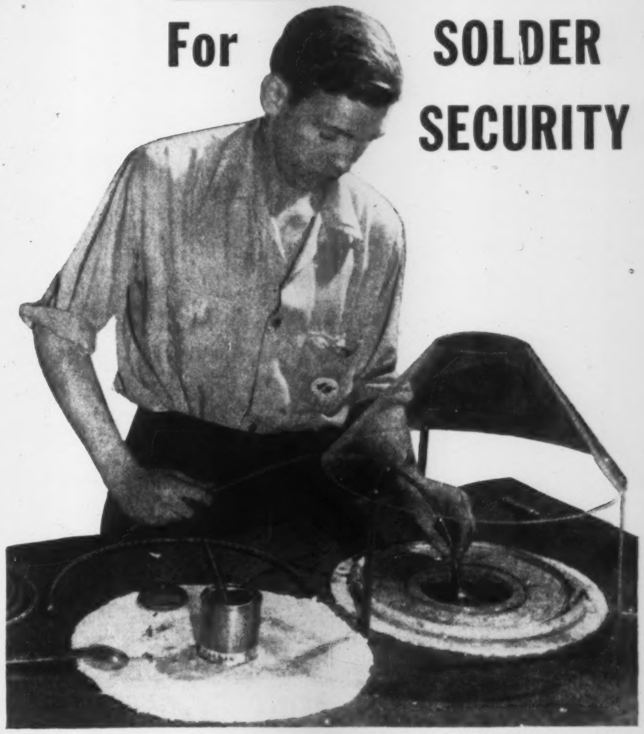

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jacket tubulation is connected to the system shown in Fig. 147, and evacuated with house vacuum. Cleaning solution (sodium bichromate dissolved in sulphuric acid) is then allowed to flow slowly into the jacket. The temperature of the cleaning solution should be about 80°C. All surfaces should be covered with the cleaning solution for a period of 30 to 45 minutes. This solution is then removed and the jacket is washed six times with distilled water. The jacket is then filled with distilled water.

Silvering Flasks or Jackets. The water in the jacket is not removed until the silvering solution is prepared. In fact, it is advisable to keep all surfaces wet to obtain a good silvered surface. The silvering solution is prepared by using a sufficient amount of solution 1. Concentrated ammonium hydroxide is added to this solution from a burette while the solution is stirred. The ammonium hydroxide is added until the precipitate which first forms just disappears. The required amount of solution 2 is then added. A dark brown or black precipitate is formed. (If insufficient ammonium hydroxide is added to solution 1, a yellow-green precipitate formed at this stage indicates that the solution has not been properly prepared. When this occurs the entire solution should be discarded.) Concentrated ammonium hydroxide is then added to the solution 1 and 2 until the brown-black precipitate is almost, but not completely dissolved. This solution can be used immediately or up to an hour after the solutions are prepared.

The water is removed from the jacket and the mixture of solutions 1 and 2 is allowed to flow into the jacket. The required amount of solution 3 is added in like manner and the contents of the jacket are shaken to insure complete mixing of solution 3 with the remainder of the jacket contents. Silvering time usually is from 10 to 30 minutes. The jacket should be rotated gently to insure silvering of all surfaces. The silvering solution is tested from time to time to ascertain whether silvering is completed. These tests are made by removing a small amount of the solution and noting the nature of the precipitate. A flocculent precipitate indicates that the silvering is completed. The solution is then removed and all sediment is carefully washed out of the jacket. The water is then removed by pumping with a cold trap between the pump and jacket. Brickwedde[14] and coworkers found that by repeating the silvering operation a better silver plate could be obtained, especially if the first silver plate was not completely opaque.

To be continued

REFERENCES

12. W. Podbielniak, *Industrial & Engineering Chemistry*, Analytical Edition, Vol. 5, 1933, page 119.
13. D. J. Pompeo and E. Meyer, *Review of Scientific Instruments*, Vol. 12, 1941, page 368.
14. R. B. Scott, J. W. Cook and F. G. Brickwedde, *U. S. Bureau of Standards Journal of Research*, Vol. 7, 1931, page 935.

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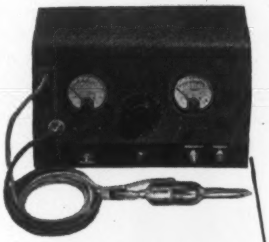

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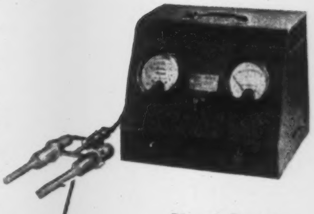

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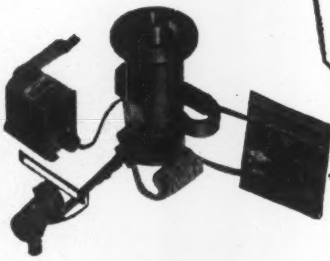

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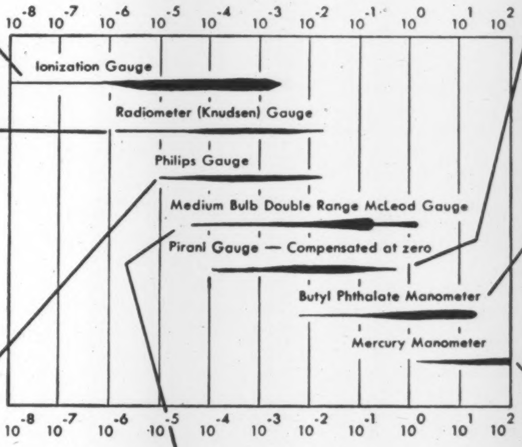

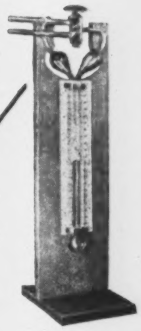

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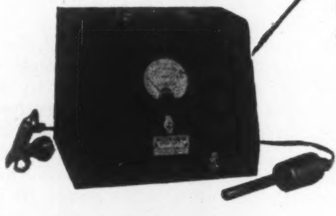

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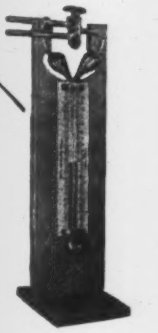

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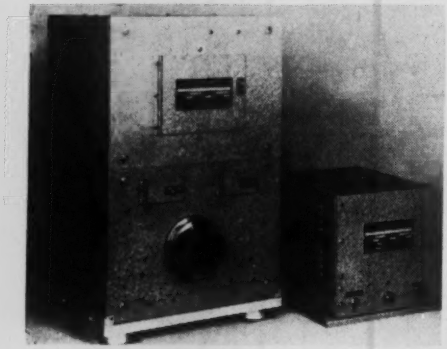
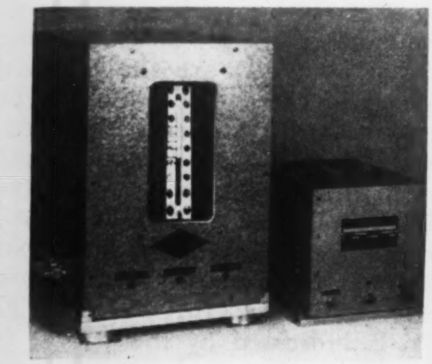


Fig. 1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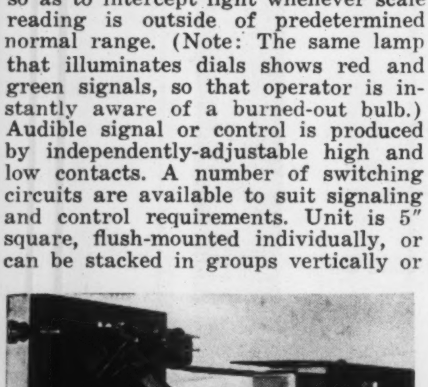
Pressure Indicator and Signal

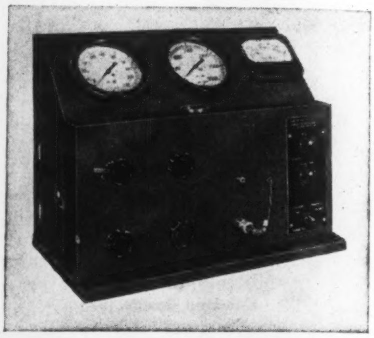
New "Indicating Pressure Signal" combines in one unit: (1) An illuminated dial (speedometer type) indicating pressure gage; (2) an illuminated red and green signal corresponding to high and low pressures; (3) high and low contacts for actuating audible signals or limiting controls, or both. Measuring element, spring-restrained bellows, is available in standard ranges from 0-15 to 0-200 lbs./in.^{2}. Green and red signals are produced by adjustable color strips carried by indicating scale so as to intercept light whenever scale reading is outside of predetermined normal range. (Note: The same lamp that illuminates dials shows red and green signals, so that operator is instantly aware of a burned-out bulb.) Audible signal or control is produced by independently-adjustable high and low contacts. A number of switching circuits are available to suit signaling and control requirements. Unit is 5" square, flush-mounted individually, or can be stacked in groups vertically or horizontally. When several units are used in multiple, a separate circuit is provided for ready cutting-out of audible signal and automatically resetting. Instrument is said to be particularly suitable for use as a safety signal on output air lines of pneumatic controllers or receiving lines of pneumatic transmitters.—*Panelit, Inc., 225 North Michigan Ave., Chicago 1, Illinois.*



Please mention number 202 when filling out card

Humidity Indicator

New "Aminco Water Vapor Indicator" provides rapid indication of water vapor content of compressed gases, and with modification of procedure for gases at or below atmospheric pressure. It measures water vapor content from saturation down to 0.001 mg./l. or less, and measurements are reproducible to 0.002 mg./l. Determinations are made in 2 to 5 minutes as compared to several hours by gravimetric method, with an accuracy comparable to that of gravimetric method. Instrument was primarily developed for checking, controlling, and inspecting the breathing oxygen supply for aviators, but it is equally applicable to gases in general, such as air, He, N, and other gases that do not react chemically with either the electrolytic film on tip of detector element or copper and brass parts of instrument. It is said that by virtue of its accuracy and simplicity, instrument can be used advantageously for determination of water vapor content (relative humidity or moisture) in gas manufacture, process control, laboratory research and control, and testing or inspecting gases under many conditions. Accuracy is better than 10% of amount of water present or 0.001 mg./l., whichever is greater. Advantages are most marked where gases of small or moderate water vapor content are tested, or where technicians of limited skill are employed. No special skill is required and no complex technique is involved. Only about 0.1 ft.^{3} of gas is used per test, which is about 1% of amount required for gravimetric tests. Deter-

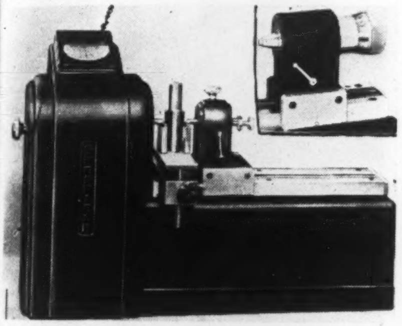


minations are made by means of a calculator that has all corrections, conversions, and deviations incorporated in its scale. "Aminco Water Vapor Indicator" was basically designed to measure water vapor content of less than 7% relative humidity. However, with certain modifications in test procedure, greater water vapor content can also be determined. Instrument is designed for saturation pressures up to 1000 lbs./in.^{2} and working pressures up to 2000 lbs./in.^{2}.—*American Instrument Co., 8010 Georgia Ave., Silver Spring, Md.*

Please mention number 203 when filling out card

Horizontal External Comparator

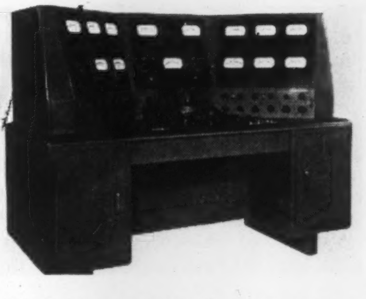
New horizontal external comparator for inspection and gage laboratory use has a wide range of adjustability, 3½" in height and zero to 10½" in length, which permits quick measurement of rectangular, threaded or cylindrical parts, tapered or straight, to millionths of an inch. New features are said to permit rapid set-up and changeover heretofore unobtainable without sacrificing accuracy. They include an adjustable pressure attachment; elevating table (easily removed); "Electrigage" head available in a wide range of amplifications; and choice of standard or micrometer tailstock (shown in insert). Use of micrometer tailstock on applications below 1" permits readings of 0.0001" from barrel without use of gage blocks or masters; if full accuracy of instrument is desired, tailstock may be set at zero, gage blocks used for set-up, and readings in millionths obtained from "Electrigage" head. This indicating unit may be obtained in amplifications of 100, 2500 or 5000. Table may be positioned horizontally within a range of 10½", and if necessary can be quickly removed. Adjustable pressure attachment knob covers range of 1 lb. to 2½ lbs. recommended by National Bureau of Standards for measuring threads by the three-wire method. —*The Sheffield Corp., 15 E. 3rd St., Dayton, Ohio.*



Please mention number 204 when filling out card

Vacuum-tube Bridge Characteristic Test Set

New vacuum-tube bridge characteristic test set is designed to reduce operator fatigue and eliminate personal errors frequently resulting from circuit arrangement. Console unit includes bridge and auxiliary switchgear mounted on control shelf; regulated power channels; bridge signal source; amplifier; indicators, and other accessories. All indicators except those for gas and heater cathode current are located on sloping panels. Voltmeters and respective ammeters are mounted close together. All ammeters have circuit jacks for external calibration. Operating from a 1500-watt 220-volt three-phase 60-cycle a-c. source, new unit will provide 0-600 volt, 100 ma. supply for plate and screen grid; 0-300 volt, 100 ma. for auxiliary and heater cathode; 0-300 volt, 400 ma. for emission; and 0-100 volt, 2 ma. for bias. A reverse polarity switch is provided for heater supply which can also be used as a second auxiliary. Filament supplies include 0-128 volts a-c, 100 voltamperes; 8 volts d-c, 5 amperes; 35 volts d-c, 2 amperes; and 128 volts d-c, 1 ampere. Console is approx. 55" high, 70" long, 34" deep and weighs approx. 1500 lbs. —*Sylvania Electric Products Inc., Electronics Div., 500 Fifth Ave., New York 18, N. Y.*



Please mention number 205 when filling out card

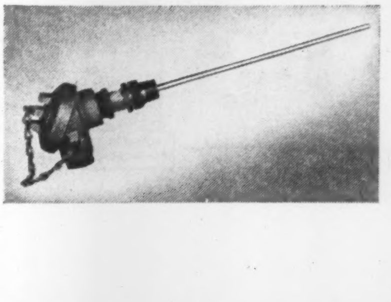
FOR YOUR GREATER CONVENIENCE

HOW often have you been keenly interested in new products but failed to find out more because you had no time to write letters? Many times, no doubt, you regretted having let the matter slip your mind.

It will take you but two or three seconds to write each number on a card. See instructions on the facing page.

Platinum Resistance-thermometer Bulb

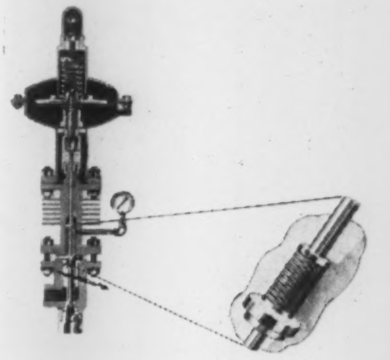
New type of industrial "Thermohm" extends the range of L&N resistance-thermometer recorders and controllers to 1000°F. and is said to be amply accurate for the more exacting industrial requirements. Speed of response is much faster than that of usual heavy-gage couples and is matched only by small pipe-type or fine-wire couples. It is easy to install in ovens, tanks, ducts or pipe lines. Its own corrosion-resisting stainless tube gives ample protection for normal pressures and non-corrosive fluids. Like any thermocouple or thermometer bulb, it can be used with protecting wells where required. Coil is protected against contamination by moisture or gases. New "Thermohm" is equipped with standard universal head that facilitates installation and connection. Standard lengths are 6" and 12". —*Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Penna.*



Please mention number 206 when filling out card

Packless Diaphragm Control Valves

New "3000 B Series" packless diaphragm control valves use packless bellows construction, which can be applied to any size or type of "Flo-tested" control valve for a working pressure of 500 lbs./in.^{2} at any temperature between 70°F and 750°F. Bellows is housed in a unit assembly and replaces conventional valve bonnet. Bellows unit, piloted into valve body and retained between two stainless steel gaskets by bonnet assembly, is protected from over-ranging by travel stops. A modified packing gland is employed as an emergency seal, should bellows fail. A tell-tale gage can be provided to indicate positively a bellows failure. Bellows unit can be easily inspected or replaced in the field, is available in two-ply Type 347 stainless steel as standard, may be mounted on any size screw-end valve from ½" to 1½" and flanged-end valve from 1¼" to 12". Whole valve lift is assured in all sizes. This design can be provided with three-way or internal pilot balanced piston type valves as well as all standard constructions.—*Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.*



Please mention number 207 when filling out card

Astronomic Dials for Time Switches

New "Astronomic Dial" time switches for lighting controls will turn lights or other electrical equipment on at sunset and off at sunrise throughout the year automatically without any attention. They may be set to operate exactly at sunset and sunrise, or up to 40 minutes before or after. Provision is also made for them to turn off at a fixed time, if desired, anywhere between 11 PM and 1 AM. Dial is equipped with a calendar wheel showing month and day as well as when switch will operate. Models equipped with astronomic dials operate on Standard Time throughout the year and are set for time correction (variation from a Standard Time Meridian) for city or town where used.—*Tork Clock Co., Mt. Vernon, N. Y.*

Please mention number 208 when filling out card

Neutral-color-lines Recorder Charts

New recorder charts are printed in neutral gray, which is said to make them easier for operators and supervising engineers to read because of greater emphasis given the various colored records. New charts are said to be especially valuable on recorders installed where lighting is poor or where it is impossible to get a clear view of the chart. Improvement in legibility is especially apparent with dark-colored recorder ink.—*Bailey Meter Co., 1050 Ivanhoe Road, Cleveland 10, Ohio.*

Please mention number 209 when filling out card

20,000,000-volt Industrial Betatron

New 20-Mev. betraton is the first high-energy electron accelerator to be made commercially available. Its prototypes have been used successfully for thick-section radiography in Ordnance arsenals (see news release on page 102). New production model (Fig. 1) is designed for plants rather than for laboratories. Manufacturer states that "ordinary x-ray technician skill is sufficient for the operator." Operating principle is acceleration of electrons by magnetic induction, first stated in Joseph Slepian's 1927 patent and first realized successfully by D. W. Kerst in 1940, but with improvements and refinements. A 180-cycle voltage applied to magnet coils produces a sinusoidally-varying magnetic field; electrons are injected as field passes through zero value and accelerated until field reaches maximum value in one direction, so that one-quarter of each cycle is utilized for acceleration. During this 1/720 of a second, however, electron stream races 350,000 times inside evacuated annular conductively-coated porcelain chamber (called the "donut") whose design and materials obviate need for a high-vacuum pumping system. Fig. 2 shows electron paths during focusing, injection and expansion. Electron gun and target constitute one assembly of small dimensions so that (1) deviation from equilibrium orbit to target is facilitated—accomplished by saturation of pole center and by a current pulse through one turn of wire on each pole face; (2) largest possible number of electrons miss injector on successive revolutions; and (3) an extremely small target size is made possible. Natural focal spot is 0.05" high and 0.005" wide and special target design reduces height to 0.01", so that a virtual "point source" results, permitting a sharpness heretofore unattainable in most industrial radiographic applications. Fig. 3 shows essential automatic-control elements: at lower left is ionization chamber which measures x-ray density; at lower right is integrating monitor circuit which trips magnet breaker when predetermined x-ray value is reached. Fig. 4 shows control cabinet. 20-Mev. x-rays are said to have (1) maximum penetration without loss of detail; (2) "absolute sensitivity" in the sense that, e.g., a 1/32" flaw is detectable in steel up to 12" thick when Eastman Type A film is used; (3) optimal latitude; (4) small diversion of secondary radiation so that no blocking is required; (5) rapid falling-off of intensity from center of narrow-cone beam facilitates protection of personnel.—*Allis-Chalmers 575, Milwaukee 1, Wis.*

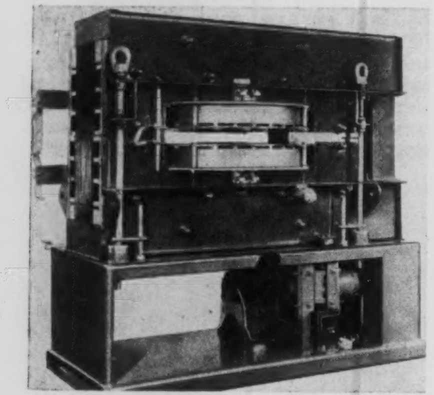


Fig. 1

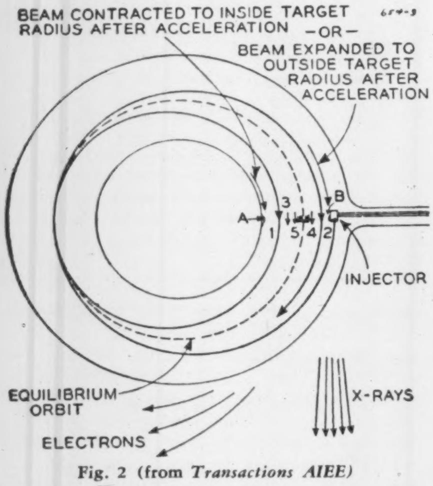

BEAM CONTRACTED TO INSIDE TARGET RADIUS AFTER ACCELERATION
-OR-
BEAM EXPANDED TO OUTSIDE TARGET RADIUS AFTER ACCELERATION
A
B
3
1
5
4
2
INJECTOR
EQUILIBRIUM ORBIT
ELECTRONS
X-RAYS

Fig. 2 (from *Transactions AIEE*)

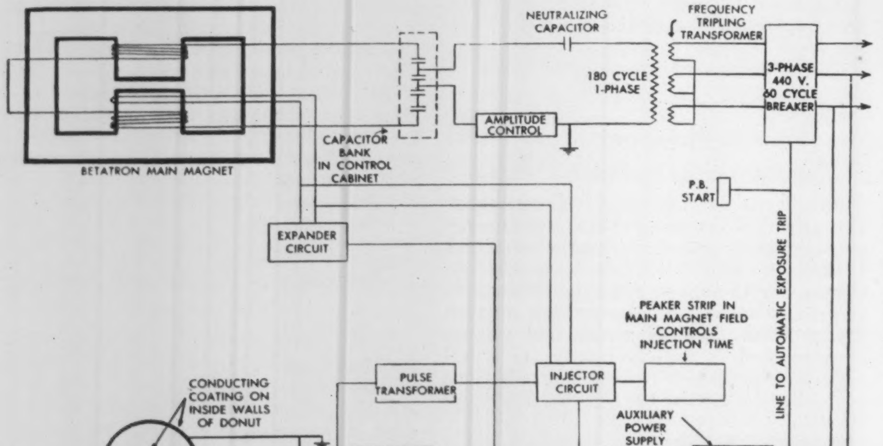

NEUTRALIZING CAPACITOR
FREQUENCY TRIPLING TRANSFORMER
180 CYCLE 1-PHASE
3-PHASE 440 V. 60 CYCLE BREAKER
AMPLITUDE CONTROL
CAPACITOR BANK IN CONTROL CABINET
BETATRON MAIN MAGNET
P.B. START
EXPANDER CIRCUIT
LINE TO AUTOMATIC EXPOSURE TRIP
PEAKER STRIP IN MAIN MAGNET FIELD CONTROLS INJECTION TIME
PULSE TRANSFORMER
INJECTOR CIRCUIT
CONDUCTING COATING ON INSIDE WALLS OF DONUT
AUXILIARY POWER SUPPLY TRANSFORMER
TARGET
FILAMENT TRANSFORMER
INDICATING R-METER
MA
DONUT (X-RAY TUBE)
X-RAYS
IONIZATION CHAMBER
MONITOR CIRCUIT EXPOSURE CONTROL

Fig. 3

Fig. 4

Please mention number 210 when filling out card

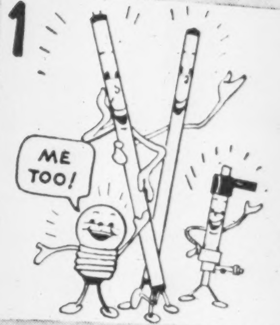
Cathode-ray Oscilloscope

New "Type 131" cathode-ray oscilloscope is claimed to feature portability, low cost and practical design for radio set servicing and general service applications. It weighs 18 lbs. Cabinet is 10¾" high, 8⅛" wide and 13¾" deep. Signal frequency range from 15 to 40,000 cps. is provided with a five-range selection control and a fine frequency

Are you in the know on GLOW?

THESE QUICK FACTS ON G-E NEON GLOW LAMPS MAY HELP YOU PRODUCE A MORE SUCCESSFUL PRODUCT

1



QUESTION—What is a neon glow lamp? What makes it glow?

ANSWER—It is the "baby" of the electrical discharge lamp family—and consists of twin electrodes sealed within a bulb containing neon gas. When the gas is ionized by application of a voltage, an orange-red glow covers the cathode.

2

HERE IS A HOT ONE

QUESTION—How are glow lamps used?

ANSWER—They're ideal as indicators. Such applications include annunciators, control panels, electrical appliances, testing devices, warning signals, pilot lights. Glow lamps also provide a source of low illumination for night lights, exit lights, dial lights, etc.

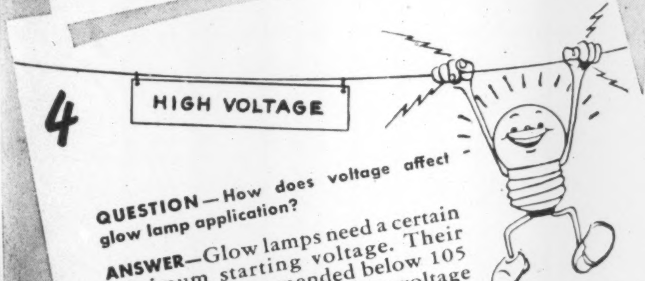
3

3000 HRS. OLD AND STILL PLENTY O'GLOW

QUESTION—What are the main advantages of glow lamps from the product designer's standpoint?

ANSWER—(a) Distinctive orange-red glow—high visibility.
(b) Dependable performance and long life—rated at 3000 hours.
(c) Very low current consumption—as little as 1/25-watt.
(d) Low brightness, low heat.
(e) High resistance to shock and vibration.
(f) Can be installed in small space.
(g) Operate directly from regular 105-125, and 210-230 volt circuits, a-c or d-c.

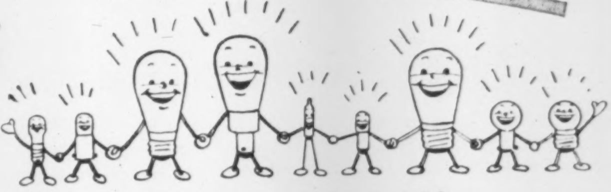
4



QUESTION—How does voltage affect glow lamp application?

ANSWER—Glow lamps need a certain minimum starting voltage. Their use is not recommended below 105 volts, but there is no upper voltage limit if resistors are provided.

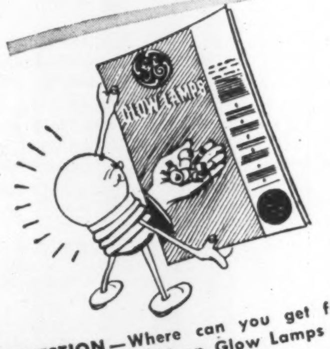
5



QUESTION—In what sizes are glow lamps made?

ANSWER—General Electric makes a complete line of neon glow lamps, in a wide variety of miniature bulb sizes, and in wattages from 3 watts to 1/25 watt, with both screw bases and bayonet bases.

6



QUESTION—Where can you get full information on G-E Neon Glow Lamps and their application to your product?

ANSWER—Write to Nela Specialty Division, Lamp Dept., General Electric Company, 1 Newark Street, Hoboken, N. J.

G·E LAMPS

GENERAL ELECTRIC

Nela Specialty Div. Lamp Dept., 1 Newark St., Hoboken, N. J.

"THEY'RE RIGHT! You can read it from any angle!"
red reading mercury
PALMER

This fellow has gone to a lot of trouble to prove how easily you can read this new Palmer Thermometer. The new Palmer Extruded Brass Case plus famous "Red-Reading-Mercury" does the trick! You now get a full, easy-to-see scale with large, clear numerals.

Other new features include "snap-on" cap; double-strength, non-rattling glass; dustproof, rustproof case with durable nickel finish. In 4, 6, 7, 9, and 12-inch case sizes. Write for new Bulletins 46-2 and 46-3 for full data.

AND REMEMBER—specify this new thermometer on original equipment purchased from your jobber or equipment manufacturer — there should be no extra charge!

Mfrs. of Industrial, Laboratory, Recording and Dial Thermometers

PALMER THERMOMETERS INC.

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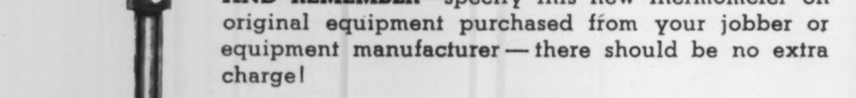
CINCINNATI 12, OHIO
Canadian Plant
King and George Sts., Toronto 2



AUTOMATIC
BECK
CONTROLS

Non-coasting
BECK MECHANISMS
for Precise Automatic Control

HAROLD BECK CO., 3642 N. SECOND STREET, PHILADELPHIA 40, PA.

control. Visual study of wave-form is provided by a 3" cathode-ray tube designed for 650-volt deflection plate operation. Sweep circuit is built around a type 884 gas triode oscillator. Tube complement includes 3AP1 cathode-ray tube; 5Y3GT/G rectifier; 7Y4 rectifier; two 707 amplifiers; and the 884 gas triode oscillator. New oscilloscope is rated at 105/125 volt; 50-60 cycle; 40 watt input.—*Radio Tube Division, Sylvania Electric Products Inc., 500 Fifth Avenue, New York 18, N. Y.*

Please mention number **211** when filling out card

Pneumatic Transmission System

New "Transet" pneumatic transmission system is said to be particularly adapted to applications involving long lead lines between transmitter and control panel, and where compactness of control panel is a consideration. It is applicable to the control of temperature, pressure, rate of flow and liquid level. "Transet" controller (Fig. 1) regulates control valve and also transmits air pressure, proportional to pen movement, to indicating receiver remotely located on a panel board. Left-hand gage of receiver unit (Fig. 2) is calibrated in the same units of measurement as controller chart, thus providing an indication of the controlled variable. Right-hand gage indicates

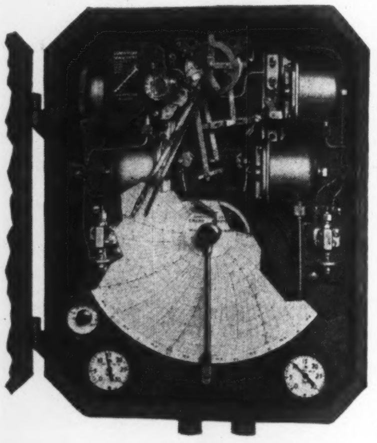


Fig. 1

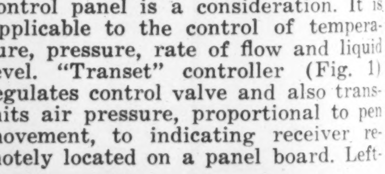


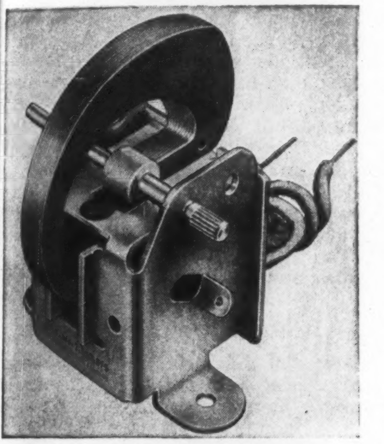
Fig. 2

tting-arm position. Thus, when both ointers of receiver unit coincide, proc- s will be under control. Controller tting-arm is pneumatically adjusted y manipulating reducing valve on ght end of receiver panel until pointr of pneumatic set gage is at desired lue. Precise control is achieved by liminating, or minimizing time lag in ntrol circuit, because controller may e located adjacent to point of measrement. Seven receivers take up no ore space than two conventional cording receiver-controllers. Hence onomy, especially on large installaons, and greater convenience for ocess engineer who can quickly check l related process variables without ving to move all over a large control om.—*Taylor Instrument Companies, 5 Ames St., Rochester 1, N. Y.*

Please mention number 212 when filling out card

180°-rotary-action Solenoid Motor

New "Rotonoid" operates as a soleoid except that it rotates through 80°, thereby producing torque instead f thrust. Armature maintains constant orque throughout its entire 180° travel. pplications include electromagnetic alves, adding and calculating mahines and numerous types of instruments. Unit is approx. 2½" × 2⅝" × 3¼" high; weighs 10 oz. Standard units ow in production have a torque of 16 in.-oz. and can be operated continuously t 20 cycles per minute without exceeding a safe temperature (60 cycles per minute for periods up to 12 minutes) on 15-volt, 60-cycle a.c. When "Rotonoid" s equipped with a current interrupter perating automatically at stroke completion, temperature rise is minimal. This means may be employed to energize the coil for the necessary time nly. A relay attachment for this purose is available. Special adaptations re possible.—*Radio Condenser Co., Camden, N. J.*



Please mention number 213 when filling out card

Tube, Battery and Set Tester

New "954-P Electronamic Tube, Battery and Set Tester" is a portable ombination mutual conductance type vacuum-tube tester, radio battery tester nd 37-range a.c.-d.c. multi-range set tester, with ranges to 6000 volts a.c. nd d.c. at 20,000 ohms-per-volt d.c. It s said to provide every facility for ac-

Ingenious New

Technical Methods

To Help You Simplify Production

New Centerless Lapping Machine Gives Precision of Less Than 2 Micro-Inches!

Centerless Lapping Machine

Now it's easy to lap cylindrical pieces—quickly—accurately—without specialized operator skill! The new Size Control Centerless Lapping Machine handles pieces from .010" to 10" diameter without costly set-ups.

The operator merely holds piece between lapping rolls with stick. Pressure applied determines quantity of metal removed. Small roll turns piece at slow constant rate. Large roll turns more rapidly to remove minute quantities of metal. Ideal for lapping oversize gages, worn gage plugs to next smaller size, bearings, bushings or shafts. Roll speeds easily changed. Adjustable for tapers.

Ideal also to save time on the job, is chewing gum. The act of chewing aids the workers' concentration; seems to make work go easier. Furthermore, chewing gum may be used even when both hands are busy—increasing worker safety—and reducing work interruptions. That is why many plant owners have made Wrigley's Spearmint Gum available to all.

WRIGLEY'S
SPEARMINT
CHEWING GUM

You can get complete information from
Size Control Company
2500 Washington Blvd., Chicago 12, Ill.

AB-54

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offers a specialized development and engineering service in
ELECTRICAL, MECHANICAL, ELECTRONIC
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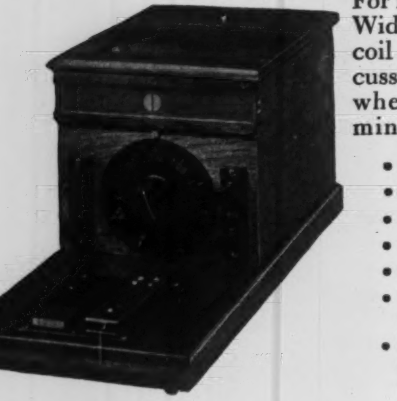
● PRODUCT DESIGNS ● PLANNING & PRODUCTION CONTROL
● TOOL AND METHODS ENGINEERING
with facilities for research, model work and pilot manufacturing.
1315 So. Clarkson Street **Denver 10, Colorado**

Speedy • Accurate
ELECTRICAL TESTING



HIGH SPEED LIMIT BRIDGE

For rapid low-cost resistance testing. Widely used for checking resistors, coil windings, heater elements, percussion caps and other similar items where inspection costs must be minimized.

- Wide range—1 ohm to 10 megohms
- Fast—up to 2000 items per hour
- Simple—for unskilled operators
- Sturdy
- Spotlight Index—for easy reading
- Versatile—suitable for rapid sorting into numerous tolerance bands
- External Standards — permit automatic temperature compensation when required

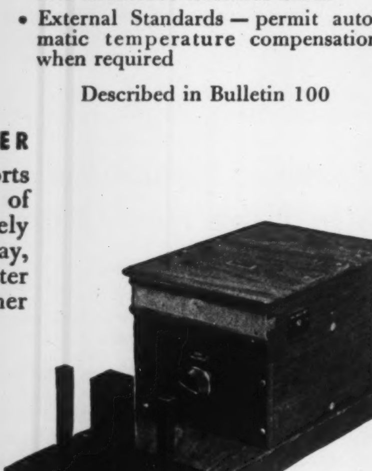
Described in Bulletin 100

SHORTED-TURN COIL TESTER

For rapid low-cost detection of shorts and opens in electrical windings of nearly every shape and size. Widely used for checking transformer, relay, magnet and solenoid windings, meter coils, motor field windings and other similar items prior to assembly.

- Simple—for unskilled operators
- Fast—up to 2000 items per hour
- Rugged
- Sensitive—1 shorted turn No.44 copper wire detectable
- 60 Cycle Test — minimizes capacity effects
- Versatile—continuity and defective insulation tests with one handling of coil

Described in Bulletin 109



PORTABLE PRECISION POTENTIOMETER

- Compact
- Sturdy
- Sensitive to within 2 microvolts
- Wide selection of ranges
- For use in laboratory, plant and field

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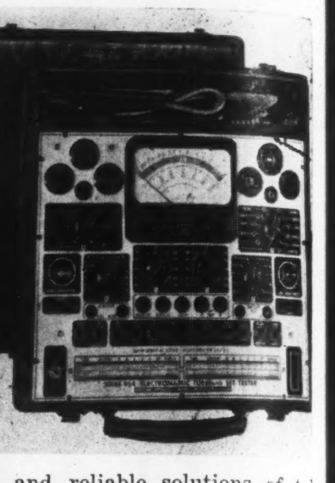
Resistance Standards • Wheatstone, Kelvin and Mueller Bridges • Precision Potentiometers • Galvanometers • Evelyn Photoelectric Colorimeter for chemical analysis • Automatic Recording Photometric Analyzers for NO and H₂S • Magnetic Permeameters • Magnetic Hardness Testers • Other equipment involving precise measurement of electrical quantities.

Literature available on request

RUBICON COMPANY
Electrical Instrument Makers
3755 Ridge Avenue • Philadelphia 32, Pa.



curate and reliable solutions of tube test, set measurement and other service or laboratory problems arising from modern radio (AM and FM), television, industrial and laboratory practice. A 4½" rectangular Bakelite cased indicator provides utmost visibility. Tube and battery analyzing features include "Electronamic" circuit, developed by maker's engineers, which in one operation tests all radio receiving tube types for both mutual conductance and cathode structure, also an automatic push-button system; free-point element terminal selection to locate terminals of all filaments, regardless of rotating pin positions. All regular a.c.-d.c. analyzing connections are made through only two polarized pin-jacks—*Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, L. I., N. Y.*

Please mention number 214 when filling out card

Carbon Monoxide Alarm

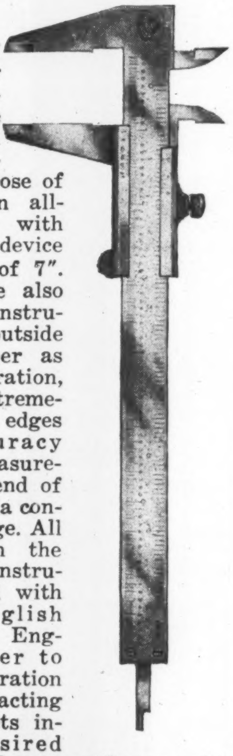
New "M.S.A. Carbon Monoxide Alarm" is designed for protection against dangerous concentrations of carbon monoxide in the air—around

CARBON MONOXIDE ALARM

blast furnaces, in steel mills, chemical plants, public garages, etc., operates continuously, giving both visible and audible warning when carbon monoxide concentration in air reaches a predetermined level. Predetermined settings can be made for concentrations as low as 0.02% (2 parts per 10,000)—a point at which a few hours' exposure would be required to produce the first symptoms of carbon monoxide poisoning. Instrument draws in a continuous sample of the surrounding air and forces it over a catalyst which oxidizes all CO to CO_2. Heat of reaction is measured by thermocouples and indicated on a dial in terms of carbon monoxide concentration. When concentration reaches predetermined setting, an alarm horn sounds and a red light jewel is illuminated. Both signals continue to operate until instrument is manually reset. Instrument is completely self-contained in a weatherproof case, requires only connection to a proper rated source of power. It consumes no more current than a 100-watt bulb and is equipped with brackets for wall mounting.—*Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Penna.*

Please mention number 215 when filling out card

Double Caliper

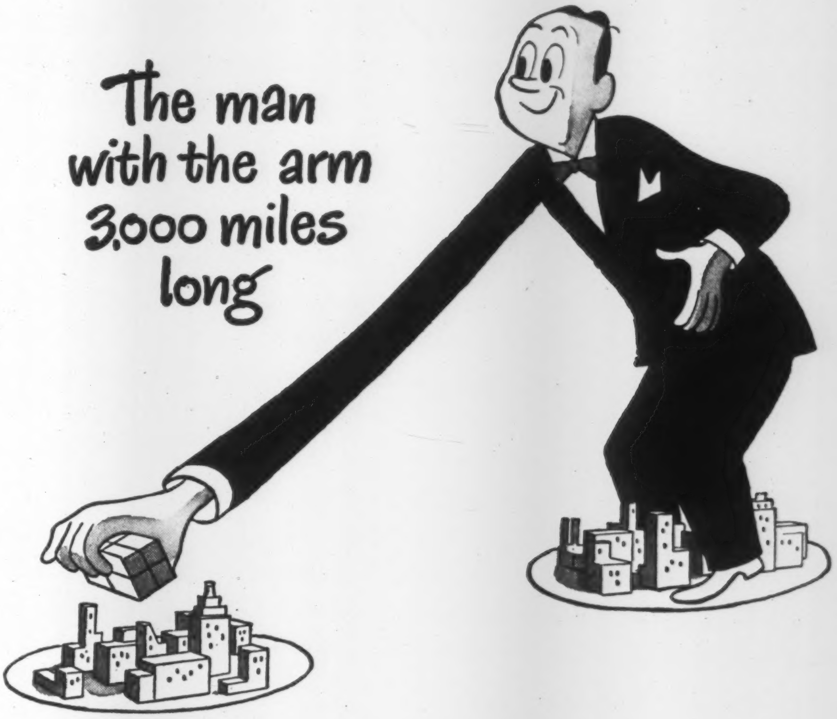


New "No. 17 Roch Vernier Caliper," described as "one of the most useful Swiss importations since the close of the war," is an all-purpose caliper with precision locking device and a capacity of 7". Larger sizes are also available. New instrument combines outside and inside caliper as shown in illustration, is said to have extremely sharp knife edges increasing accuracy and ease of measurement. At other end of the instrument is a convenient depth gage. All readings are on the same vernier. Instrument is supplied with Metric and English reading or with English only, latter to 0.001". As illustration shows, a quick-acting precision lock sets instrument at desired position by thumb-screw. New vernier is supplied with form-fitting leatherette plush-lined case with cover. Undersigned company also imports a micrometer with barrel readings to 0.001" and dial readings to 0.0001", which also has special indicators on dial for use as a gage to check tolerances.— *Park Sales Co., 417 Canal St., New York 13, N. Y.*

Please mention number 216 when filling out card

Audio and Supersonic Frequency Meter

New "Type 838 Frequency Meter" for electrical, radio, acoustics measurement, recording, telephone and telegraph laboratories, is a direct-reading instrument designed to measure frequencies in the audio and supersonic spectrum. Seven overlapping ranges are available for frequency determination between 20 to 100,000 cps. Accuracy on all ranges is ±2% of top frequency on range in use. Instrument is said to have a high input impedance


The man with the arm 3,000 miles long

In his business — just like yours these days — he is always running out of supplies and parts he needs in a hurry. Yet customers have to be satisfied.

Well, he doesn't have a nervous breakdown. He doesn't lose customers. Instead, he gets *what* he needs *when* he needs it by specifying Air Express delivery.

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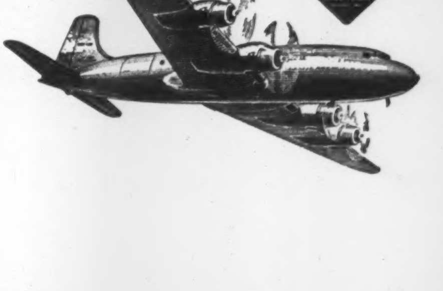

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Alinco Magnets in all DC Instruments—Phosphor bronze control springs—perfectly aligned jewel supports—non-shifting balance weights—added to its many other superior construction features enables Burlington Instruments to maintain critical characteristics.

All ranges AC or DC available in 2½", 3½", 4½" sizes, rectangular and round. *Inquiries invited for your specific requirements.*

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It's "Touch and Go"!
REVOLUTIONS PER MINUTE IN HUNDREDS

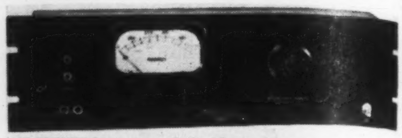
with the CORBIN Hand Tachometer

NO LAG . . . the pointer swings around instantly — follows every change of speed, giving a positive, steady reading at all times. CORBIN cross-balanced centrifugal governor eliminates oscillation . . . mechanism requires no lubrication. Packed in box with rubber pointer, rubber cup and rubber-tired wheel. Choice of ranges and dial markings.

Corbin Screw Division
American Hardware Corp.
New Britain, Connecticut

PA-2

Accurate CORBIN Tachometers



and to require a small minimum voltage for stable indication. Indication is substantially independent of variations in input voltage between 0.5 and 150 volts r.m.s. Panel measures 5¼" × 19" and is designed for standard rack mounting. A walnut case may be supplied for applications requiring bench use. Indicator is large, easy-to-read and illuminated. Where a continuous graphic frequency record is required, a jack has been provided for connection to an external recording milliammeter.—*The Daven Co., 191 Central Ave., Newark 4, N. J.*

Please mention number 217 when filling out card

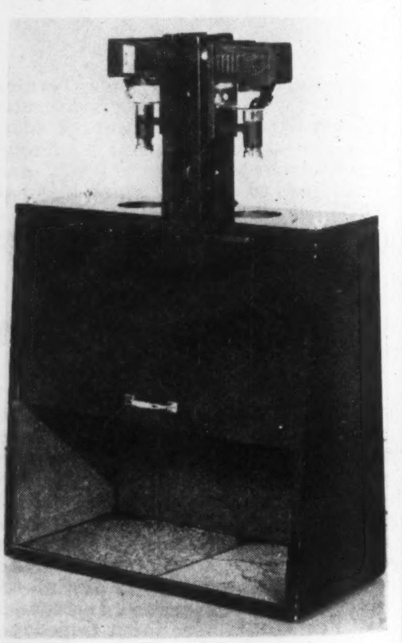
Cut-out Switch for Temperature Instruments

New cut-out switch makes possible centrally-located periodic temperature measurements for industrial processing; is especially adaptable to petroleum and chemical industries. It consists of a double-pole, double-throw mechanically-operated push-button switch for multi-point indicators. It is said to provide cheaper and more practical installations for many critical applications than would a plurality of individual instruments.—*Brown Instrument Co., 4482 Wayne Ave., Philadelphia 44, Penna.*

Please mention number 218 when filling out card

Comparison Projector for Surface-finish Replica Films

New "Model D-30 Faxfilm Dual Projection Unit" instrument provides quick comparison of a production finish with a standard finish, may be used with curved and conical shapes and inside or outside diameters as well as on flat surfaces. It is easily portable, weighing 27 lbs. and requiring two

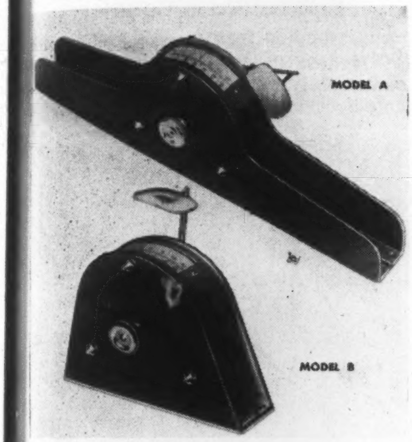


square feet of bench space. Set-up at inspection point takes two minutes. "Faxfilm" is process by which a plastic replica of a surface is made in less than a minute and projected in a microprojector (see *Instruments*, Nov. 1944, page 716). In new unit, "Faxfilms" of a standard finish and of a production finish are projected by two microprojectors mounted at top of case, images appearing side by side at 30X on a screen at base of case. Openings on either side of case permits operator to view images, measure them or point to specific areas in a discussion of them. Wollensak 1" f:2.46 lenses provide excellent definition of minute surface irregularities. Rheostats for each projector equalize light intensity.—*The Faxfilm Co., Room 540, 1220 W. Sixth St., Cleveland 13, Ohio.*

Please mention number 219 when filling out card

Vernier Angle Gage

New model of Clinometer Vernier Angle Gage has an all-aluminum housing for lighter weight; a new special window for easier reading and improved stability; and other new mechanical features. Models "A" and "B" are for general purposes; other models are for specialized fields. — *Engis Equipment Company, 431 South Dearborn Street, Chicago, Illinois.*



Please mention number 220 when filling out card

Automatic-reset Industrial Timer

New "Mars" synchronous-motored timer is designed for direct control of loads up to 1 kw. at 115 volts 60 cycles, is provided with multiple circuit switching whereby one electric circuit is energized for a pre-set time interval while another circuit is simultaneously de-energized for the same interval. Standard receptacles allow quick connection of controlled circuits. A rim-set dial permits rapid, accurate selection of any time interval from one to seventy-five seconds. One luminous hand indicates interval for which timer is set; another shows elapsed time during entire cycle. Time cycle is started by pushing a button on control panel; for remote control a momentary-contact switch can be connected to a receptacle provided for this purpose. Upon completion of time cycle, switching circuits are automatically reset and elapsed-time indicator resets to zero. Thus, time cycle can be repeated at

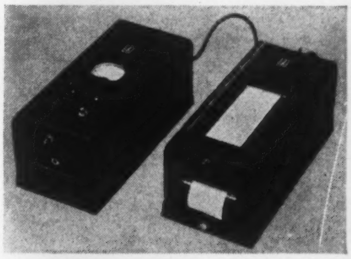
Brush Magnetic Oscillographs

make direct-writing recordings of strains and pressures instantaneously!

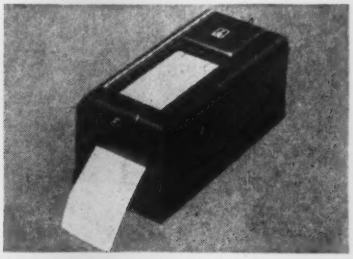
The remarkable new Brush Magnetic Recording Pen Motor—heart of the Brush Direct-Inking Oscillograph. Highly stable. May be used under virtually any climatic or temperature conditions. Exceptional accuracy.

Instantaneous, permanent, ink-on-paper recordings by Brush Oscillographs make their use almost unlimited. Accurate recordings of strains, pressures and countless electrical phenomena can be made over a frequency range of D.C. to 100 c.p.s. Either A.C. or D.C. circuits can be measured. Whenever desired, recordings may be stopped for notations on chart-paper.

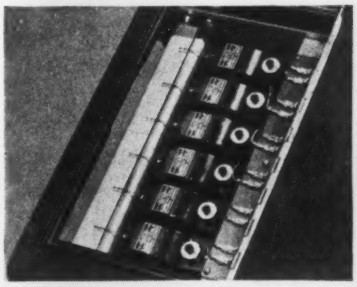
Brush Oscillographs are compact, portable and ruggedly constructed for ease of handling and operation. Investigate them now. Brush engineers will gladly co-operate in determining their application to your problems. Write for technical information for complete details of this equipment. Special bulletins are available on strain-gauge use.



Brush Single-Channel Magnetic Oscillograph with amplifier. Especially suited for strain-gauge applications, counting, surface analysis and similar applications. Three-speed paper drive, 5, 25, 125 mm per second. Chart paper 2⅜" wide.



Brush Double-Channel Magnetic Oscillograph for use where two simultaneous recordings are desired as in synchronizing problems. Three-speed paper drive, 5, 25, 125 mm per second. Chart paper 3 15/32" wide. Rugged construction.



Brush Six-Channel Magnetic Oscillograph. Excellent for strain-gauge recordings. Dust-proof case. Interchangeable gear paper drive. Your choice of paper speeds from ⅛" to 5" per second. Chart paper 12" wide. Compact design.

The Brush Development Co.

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This is the season
for **GROUND TESTING**
wet, or dry

Testing of resistance to earth, of man-made grounds under all conditions, is done more *accurately*, more *easily*, more *speedily* with the VIBROGROUND.

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Ground Resistance Tester

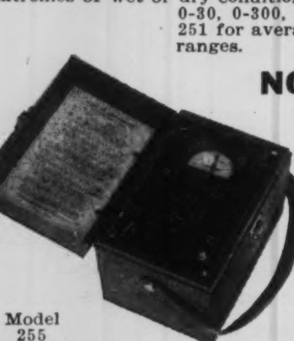
Sturdy, compact, dependable. Easily portable. Precision engineered throughout. No calculations. No reverse readings, nor polarization errors. All AC and DC strays excluded. New Model 255, illustrated, for extremes of wet or dry conditions. Four ranges, 0-3, 0-30, 0-300, 0-3000 ohms. Model 251 for average conditions, has 3 ranges.

NO CRANKING

Like all Associated Research products Vibroground is *thoroughly modernized.* Has most dependable self-contained power source. No tiresome cranking. Just press button, balance galvanometer, and read directly at potentiometer pointer.

Send for new Catalog 104 with complete engineering details.

Also mfrs. of Vibrotests insulation resistance testers, full line of testing instruments, Keeler Polygraph (lie detector), etc. Engineering service representatives in all principal cities.



Model
255

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Plastic
RADIO DIALS

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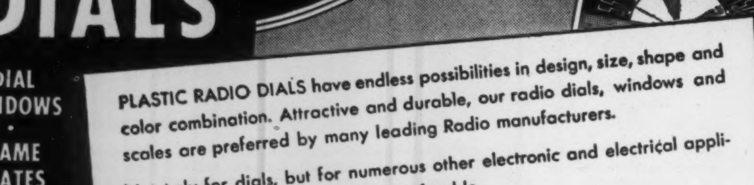
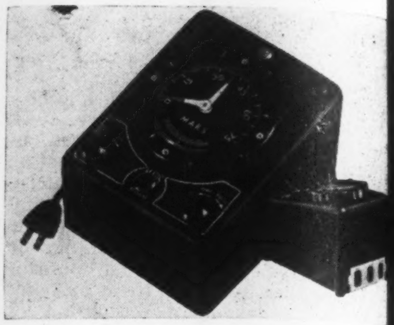


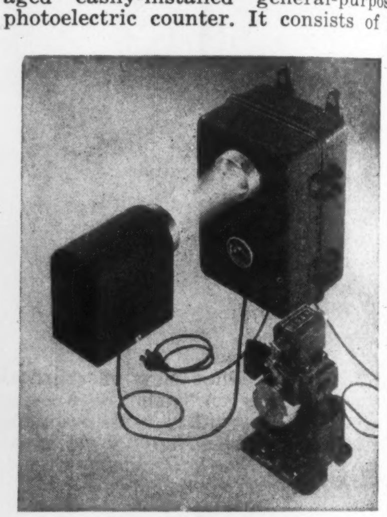


will, by pushing starting button. A manual switch provides control during adjustments or when it is unnecessary to synchronize the operation to the timer. If it is desired to extend or shorten pre-set time, at any time during the timing interval, new interval can be set without interrupting operation. A power switch turns off all power when instrument is not in use.—*Lancaster Products, South Lancaster, Mass.*

Please mention number 221 when filling out card

Photoelectric Counter

New "Type P1 Photoelectric Counter" is described as a completely-packaged easily-installed general-purpose photoelectric counter. It consists of a

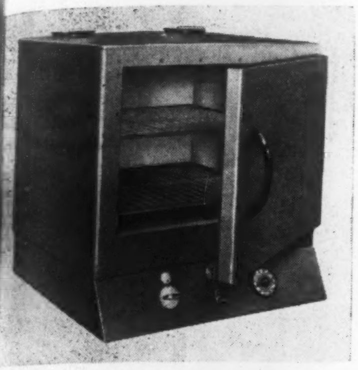


photoelectric control, light source, and electric counter. One or more electric counters (containing counter face and reset knob) may be placed at any convenient location and wired to the control. Installation is simple: no wiring is necessary; line cord male plug fits any standard lighting outlet; light source and electric counter have cables and plugs for plug-in connection to the control; entire equipment can be installed without help of an electrician. Speed of operation: up to 600 counts per minute; operating range: 6 feet between photoelectric unit and light source; maximum number of counts before returning to zero: 99,999.—*Photoswitch Inc., 77 Broadway, Cambridge 42, Mass.*

Please mention number 222 when filling out card

Laboratory Oven

New "Model 5700" laboratory oven equalizes interior heat by a simple double-venting device, is designed for

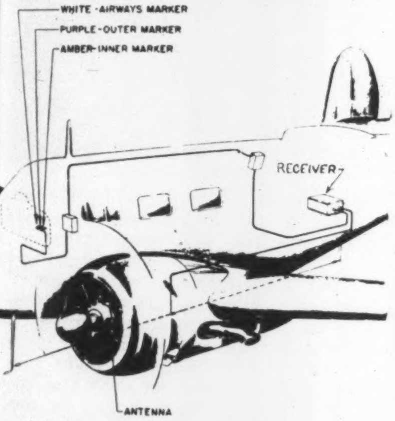


se in chemical laboratories doing precipitation, ash content and similar eneral chemical laboratory work, steel rawings, etc. Thermostat controls mperatures from 0° to 550°F. and a imer maintains desired temperatures or various periods. Even distribution f heat is accomplished by two large ents, on either side of top of oven, hich serve also to remove obnoxious r unwanted fumes and gases. A third, maller, vent permits inserting a thermometer. Interior of standard model lined with steel and a baked aluminum surface. For special uses, a stainess steel work chamber is available. nterior dimensions are 20″ × 15″ × ″. Outside dimensions are 24″ × 6½″ × 24″. Oven consumes 2800 watts t 110 or 220 volts single-phase a.c.—*he K. H. Huppert Co., 6830 Cottage rove Ave., Chicago, Illinois.*

Please mention number 223 when filling out card

Marker Receiver for Instrument Landing Systems

New "Model MBR-1 Marker Receiver" intended to provide reception of the 5-Mc. airway and instrument landing markers, with aural and visual indication. It consists of (1) Remote Receiver located in the radio compartment, controlled by an on-off switch within pilot's reach, using primary power supply from standard 24-volt aircraft battery, and automatically receiving the marker signals; (2) Three-light Indicator, located on instrument board, shows aircraft's passage through the marker field. A white light denotes airway markers, amber light denotes inner markers, and purple light denotes outer markers. At the same time, pilot hears appropriate note in his headphones: 3000 cps. for airway markers, 1300 cps. for inner markers, and 400



DECADE SCALING UNIT

TYPE YYZ-1

THIS unit offers the research laboratory a quick and effective means of counting the number of pulses from any desired source. It will prove invaluable in such studies as:

- **Nuclear Research**
- **Radioactivity**
- **Mass Spectography**

In addition it will be found extremely useful:

- **For Timing Purposes**
- **For Counting Rapidly Recurring Phenomena**
- **For Use in Conjunction with Calculating Machines**

For additional information, write: *General Electric Company, Electronics Department, 1-6411, Syracuse 1, N. Y.*

GENERAL ELECTRIC

164-F1

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*T.M. REG.

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- **LONG LIFE thru wear and vibration Resistance**
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- **NON-MAGNETIC**
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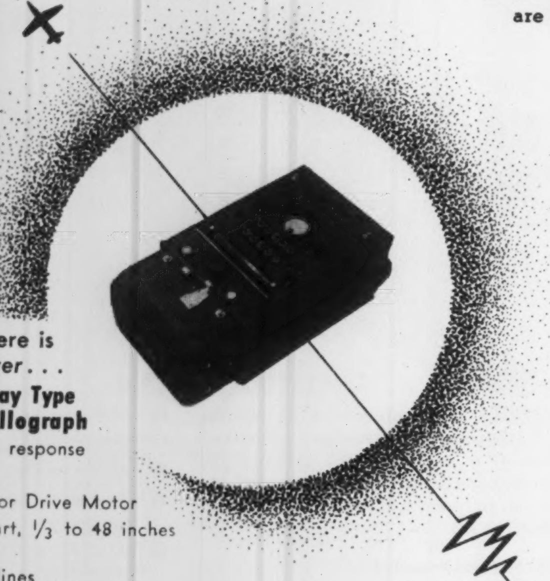

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where PORTABILITY
and ACCURACY
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. . . There is
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- High-frequency response
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- Internal Governor Drive Motor
- Gear-driven chart, 1/3 to 48 inches per second
- Accurate time lines
- Automatic record length control
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Interval Timers

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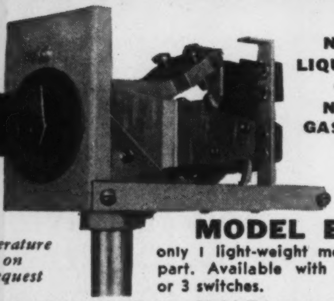

BURLING
TEMPERATURE
LIMIT SWITCHES

NO LIQUIDS
·
NO GASES

MODEL E
only 1 light-weight moving part. Available with 1, 2 or 3 switches.

Literature on Request

As a 3 switch model, Burling Model E is recommended for use (a) where load is divided into 3 parts, (b) where 1 switch is used for controlling, one as a high limit, one as a low limit, (c) to give definite stops or position to a 3 or 4 position diaphragm motor, (d) to give 3 speed control of variable speed motor.

Accurate, rugged, dependable. Corrosion and heat resisting tube. Dial pointer for easy setting. Locking screw locks temperature setting. Increased adjustable range to 700-1000°. Dimensions: 7¼" x 2¾" x 3½". Vapor tight base and cover with gasket available at slight extra charge.

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Making Precision Controls for over 10 years
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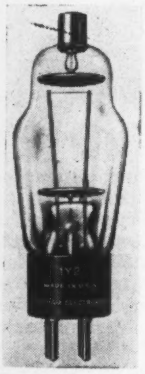
Newark, N. J.

cps. for outer markers. New "MBR- Marker Receiver" is said to be th lightest and the most compact such in strument in existence. It weighs 7 lb 11 ozs.—*Lear Inc., 101 Ionia Ave., N.W Grand Rapids 2, Mich.*

Please mention number 224 when filling out card

Television Rectifier

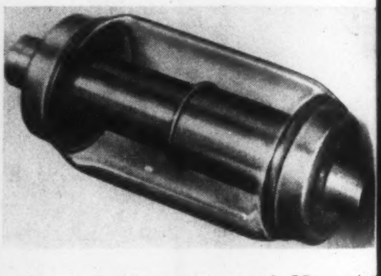


New "Model 1Y2" is high-voltage rectifier de signed for anode suppl on direct-view or proje tion type television tube Peak inverse voltage ra ing is 50 kv. Filamen voltage is not critical may fluctuate betwee 1.0 and 1.65 volts. Fila ment is amply rugge for 60-cycle operatio and requires low fila ment power making equally adaptable to a rf. filament supply. In terelectrode capacitanc and absence of bac emission prevents undue loading of th oscillatory circuit in rf. applications It is said that "1Y2" particularly rec ommends itself on basis of adaptabilit to low-cost circuit design. Two tube deliver 50 kv. d.c. in a voltage-double circuit or 25 kv. d.c. singly.—*Chatha Electronics, 475 Washington Stree Newark 2, N. J.*

Please mention number 225 when filling out card

Vacuum Capacitor

New "VC-50" vacuum capacitor rate 30,000 volts maximum peak voltage an having a capacitance of 50 micromicro farads ±2% has maximum rms. curren

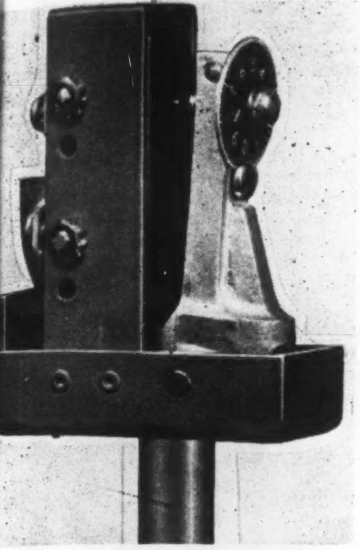


ratings of 65 amps. at 10 Mc. and 4 amps. at 60 Mc., based on maximum glass-to-metal seal temperature of 150 C. Internal losses are largely ohmi (I^2R) and decrease as frequency de creases. Voltage increases as frequen cy decreases, reaches maximum allow able peak voltage rating of 30 kv. a 10 Mc. At frequencies lower than 1 Mc., peak voltage becomes the limiting factor. New capacitor may be used a lower frequencies if peak voltage rating is observed. Maximum overall dimen sions: length 6.6"; diameter 2.5".—*Amperex Electronic Corp., 25 Washington St., Brooklyn, N. Y.*

Please mention number 226 when filling out card

Temperature Limit Switch

New "Model S-V Temperature Limi Switch" for maximum temperature o 700°F. is designed for aviation use, be ing small and light in weight, with a efficient snap-action switch rated 1 amp. 24 volts at 40,000 feet altitude Total weight including cover and 7⅛ tube is 9 oz. Use of an aluminum tube



itable for lower temperature brings ight down even lower. Dimensions: " tall × 2¼" wide × 1¼" thick. For mersion in oil a special compression e fitting is also available.—*Burling trument Co., 251 Springfield Ave., wark, N. J.*

Please mention number 227 when filling out card

Sub-miniature Electron Tube

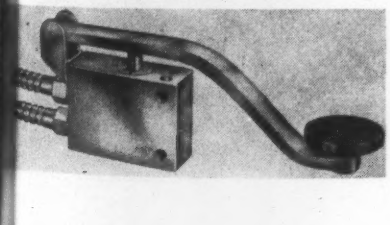
New electron tube (extreme left), id to be the smallest in the world, kes wartime proximity fuze tube hird from left) look big. New tube is

" long and slightly more than ⅛" in meter. It is shown in comparison th (right to left) conventional tube ten years ago, current lock-in tube d proximity fuze tube.—*Sylvania ectric Products Inc., 500 Fifth Ave., w York 18, N. Y.*

Please mention number 228 when filling out card

Three-way Valves

New "FT" models of three-way ingertip Valve" are quick and easy- ing, yet are said to have sufficient pacity to give fast action to cylin- rs up to 4" bore. Four styles are ailable for different purposes as fol- ws: (1) "Model FT-1" (for ¼" I.D. " or ⅝" O.D. hose) normally closed. tuates cylinder when button is essed, exhausts it when button is re- ased. (2) "Model FT-2" (for ¼" I.D.



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CONVERTS SMALL D-C VOLTAGES TO MEASURABLE CURRENTS

Here's a new electronic device that extends the range of conventional indicating and recording instruments so that they can be used for high-sensitivity measurement of low d-c voltages and direct currents. It provides an economical means for making measurements that, heretofore, required complicated and costly equipment. Other applications are: telemetering, temperature measurement, analysis of electronic circuits, and to initiate control when used with sensitive relays.

LOW CURRENT DRAIN—Puts no load on the measured circuit.

FULLY AUTOMATIC—Requires no manipulation to obtain balance.

ADJUSTABLE RANGES—Easily changed resistor permits selection of input ranges from 100 microvolts to one volt d-c full scale with five-milliampere output.

RAPID RESPONSE—Circuit balances automatically in approximately one second on 200-microvolt range, faster on higher ranges.

WIDE-RANGE OUTPUT—Permits use of indicating or recording instruments having resistance up to 1500 ohms.

Complete details are listed in Bulletin GEA-4625. Call the nearest General Electric office for your copy or write to *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.* **PRICE $200**

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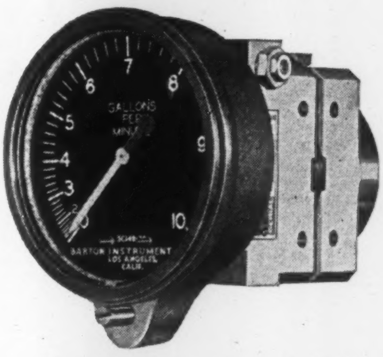
Differential Pressure INDICATOR



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Suitable for Static Pressures Up to 3,000 P.S.I.

HAS RUPTURE-PROOF BELLOWS UNIT

An exclusive feature. Sensitive and accurate under high operating pressures. Withstands extreme over-ranging.

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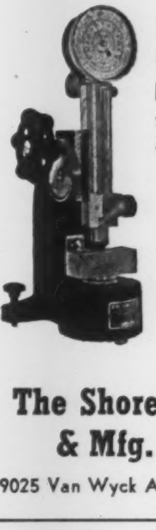

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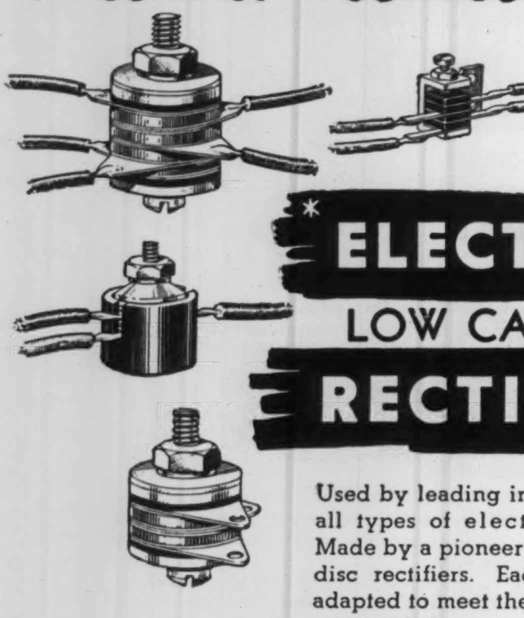

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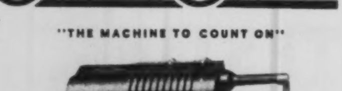

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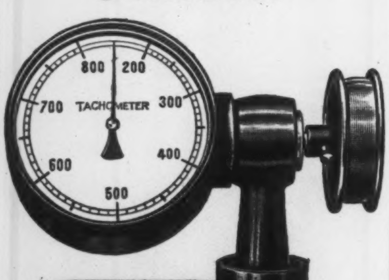

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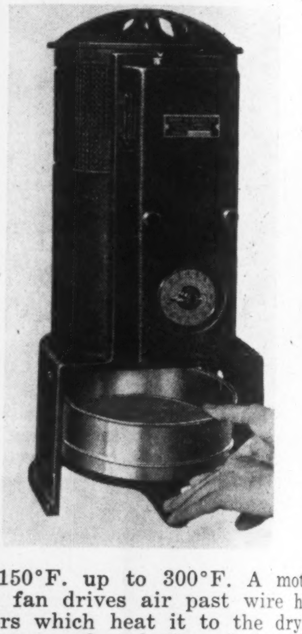
Moisture Tester

New "Model 278 Moisture Teller" will receive an 8" diam. drying pan. Pans of various depths may be used. Automatic temperature control is provided from 150°F. up to 300°F. A motor-driven fan drives air past wire heat resistors which heat it to the drying temperature selected. Heated air is then forced through test samples, then passes through Monel metal filter cloth bottom of the 8" sample pan. Most samples can be dried within 2 to 3 minutes. Sample is weighed before and after. Instrument is available for either 115- or 230-volt supply.—*Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4, Mich.*



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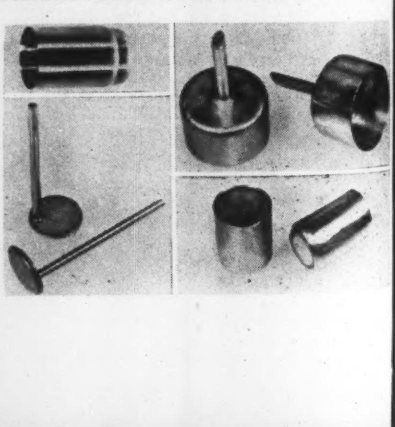
Stainless-steel Laboratory Filters

New stainless-steel laboratory filters with porous stainless-steel filter elements include filter crucibles, Buchner funnels, gas dispersion tubes and filter tubes, are available in five porosities from "very fine" to "very coarse." They are made up by welding the porous stainless-steel filter element into solid stainless-steel filter bodies. In addition



to freedom from breakage, the filters show other advantages: they can be heated and cooled without danger or cracking; higher flow rates for any given pore size are obtained than with other types of filters; availability of industrial filter units made up with the same filtering material is advantageous in research and development work.—*Micro Metallic Corp., 193 Bradford St., Brooklyn 7, N.Y.*

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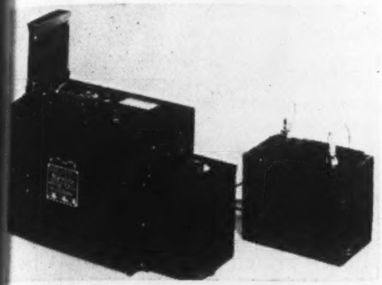
Moisture Tester

New "Battery-operated Steinlite" moisture tester is said to be particularly adapted to field use and to areas where electricity is not available. Operation by an automobile storage battery is recommended. Approx. 1600 tests can be made before recharge. Under normal conditions one charged battery will operate instrument for approx. 30 days in busy season. In an emergency, unit can be operated by a -volt "hot shot" battery which lasts about 30 minutes. New unit, similar in appearance to standard "Steinlite," also can be plugged into a 110-volt line; cannot be damaged by connection to a 110-volt line and to storage battery at the same time. To avoid wear n battery, new unit is equipped with time switch for automatic shut-off when test is completed. — *Seedburo Equipment Co., 223 W. Jackson Blvd., Chicago 6, Illinois.*



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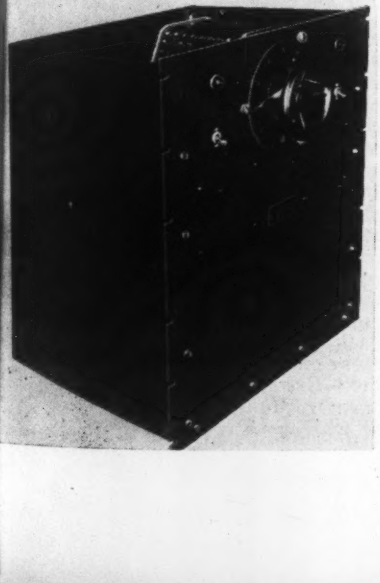
D-c. Power Supplies

New "Seco" d-c. power supplies are announced. Pictured is a 0-3000 volt model, designed for continuous duty, small regulation and easily-adjusted output voltage. Maximum d-c. output current is 0.5 amp. Unit operates from



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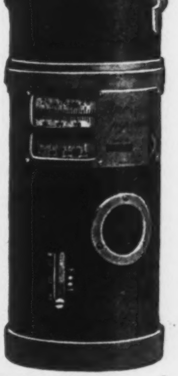

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a 115-volt single-phase 50/60 cycle source. It uses a full-wave bridge rectifier consisting of four type 866/866A tubes. A time delay relay allows filaments to be adequately heated before high voltage is applied. Line fuses protect against possible overload. All major components are either potted in metal enclosures or are hermetically sealed. Unit is supplied for mounting in a standard 19" relay rack panel. An external metering panel is available. Three controls and two indicator lamps are mounted on panel. These are the a-c. line switch with indicator lamp; high voltage primary switch with indicator lamp; and "Powerstat" variable transformer control. — *The Superior Electric Company, 130 Church St., Bristol, Conn.*

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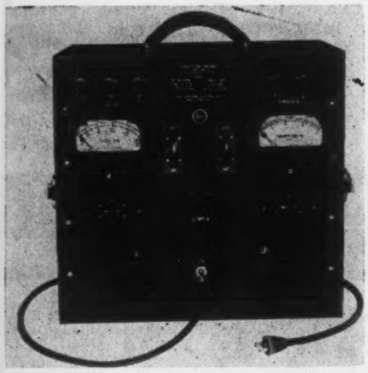
A-c. Power Supply.

New "Voltbox" a-c. power supply has been designed primarily to meet needs of electric light company testmen but will find diversified applications. It is a portable source of metered continuously-adjustable a-c. voltage and current: three ranges of output voltages and two ranges of output current, achieved by two "Powerstat" variable transformers operating in conjunction with auxiliary transformers. Voltage and current are varied independently and are electrically isolated from each other. Triple-range voltmeter and double-range ammeter can be used also to measure external voltages and currents by throwing lever-action switches located below them. Circuit has been designed to permit use of this device on either 115- or 230-volt 50/60-cycle power lines. Output voltage ranges are 0-30, 0-150, and 0-300 volts; current ranges are 0-5 and 0-20 amperes. A circuit-breaker offers complete instrument protection.—*The Superior Electric Co., 230 Church St., Bristol, Conn.*



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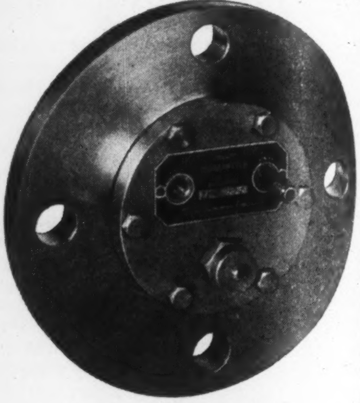
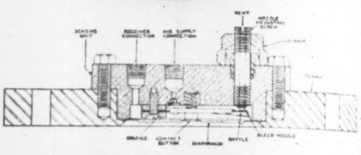
Liquid-level Transmitter

New "229RF" liquid-level transmitter is designed to solve problem of having a conveniently located instrument which will accurately indicate or record the level of liquid in a remotely located tank. Non-clogging and corrosion-resistant unit measures level and transmits an air pressure proportional to this level. It is particularly applicable for measuring level of viscous liquids or liquids with solids in suspension; liquids or solutions which solidify in the usual pressure or manometer connections; also for relatively low pressure measurement (up to 17 lbs./in.²) of corrosive gases or liquids. Unit consist of a metal diaphragm in a 3" 150 lbs./in.² stainless-steel flange which ca be attached to bottom or side of an ope or vented tank. It operates on force balance principle. Being a 1-to-1 transmitter, output air pressure is equal t applied pressure or liquid head and ha a range of 450" of water with an accuracy of ±1" of water.—*Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y.*





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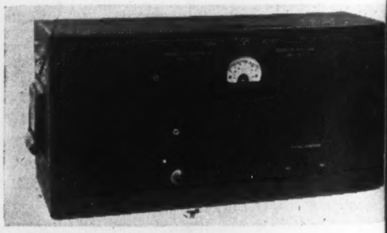
Capacitance Relay

New "Model DD-20 Capacitance Relay" enables changes in capacitance t control external devices or circuits. A panel instrument indicates capacitanc changes of as little as 0.01 micromicrofarad, in addition to relay operation which can be obtained with changes o 0.05 $\mu\mu$f. or more. Sensitivity is var able to suit demands. Output provisions ar made for supplying 115 volts a.c., closed circuit, or open circuit upon operatio of relays. Self-contained power suppl is regulated and is designed to operat from 115-volt 60-cycle a-c. source. Applications include contactless control safety control, automatic illuminatio control for stairways or corridors i presence of persons, limiting of linea motion, etc. Unit is suitable for rack mounting and is supplied with 8¾ rack panel and enclosing cabinet. Dimensions: 9" × 19" × 11", weight: 3 lbs.—*Browning Laboratories, Inc., Winchester, Mass.*



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JOURNAL of the Instrument Society of America

Editor, R. R. PROCTOR, 2213 Ridge Ave., Evanston, Ill.

ol. 2 FEBRUARY 1947 No. 2

Editorial

COOPERATION

Any group, whether it be a family, society, a corporation, or other type f organization, must practice coopera-ion if it desires to remain intact and row or otherwise advance as it should. t is a certainty that without coopera-ion such groups would never have en formed in the first place.

The I.S.A. is no exception. We have en this organization grow from a mall group of once self-sufficient local cieties into a healthy, rapidly-growing ational Society, and no one will deny at this has taken a tremendous mount of cooperation. Most of us may ver know much about the difficulties d headaches which confronted, and re surmounted by, those responsible r the welding together of these indi-dual groups into what is now the strument Society of America.

However, only half the job is done! e other half of the job is to see that *continue to cooperate* so that the ciety may serve in its full capacity d advance without hitch to the end at it can soon assume its rightful ace as one of the pillars upon which nstrumentation for Tomorrow" will dependent. We, individually and as ctions, and of our own volition, must ve time and effort and cooperation to ure our reaching the goals we have tablished. *Anything* we can do to omote better cooperation amongst rselves, therefore, should be our first nsideration.

From time to time it may be neces-y to build small fires under certain ividuals (or Sections, for that mat-) who, for one reason or another—ne of them legitimate—fail to co-erate fully and hence tend to retard r advancement as a Society. Misun-rstanding is forgiven, for we are too ung to have ironed out all the kinks yet; a certain measure of procras-ation is tolerated — temporarily — cause the fire-builders themselves are out to pop their safety valves under e extreme pressure of their present tivities; but laziness, lack of interest, competence, or out-and-out non-co-erative activities (which only feed re fuel to the fires now burning rrily under the fire-builders) must corrected immediately. The under-ng causes must, of course, first be ought out into the open where they n be analyzed, and part of this ac-ity necessarily devolves upon the itors of the Society's publications.

Theoretically, at least, we (Ye Edi-r) may therefore be classed as one the fire-builders, but this discourse not meant to be a fire. (Well, just a little one, maybe!) However, to avoid being accused of forever talking about the weather but never doing anything about it, we offer herewith a few suggestions which may help postpone or even remove the need for building a good many of the above-mentioned fires.

1. Whenever you, or you, or you, receive a letter or a request for information or help, whether from an officer, delegate, committee chairman, or any other member, try to answer it *as soon as possible*. Sometimes a few hours makes a lot of difference in the value of such information.

2. If you question anything concerning the activities of the Society, or have suggestions or criticisms to make, bring the matter out in the open by writing to someone who can properly take care of your problem. The Secretary's office and/or the Editor's office are good clearing houses for this sort of thing.

3. For better cooperation between Sections, we suggest (in fact, request) that each Section Secretary immediately put the names of every other Section's Secretary, Delegate and *Journal* Correspondent on the general mailing list to receive all publications or meeting announcements issued by his Section. (*Journal* Correspondents, please follow up on this.) In this issue will be found the names of all the above-mentioned men, and each Section should henceforth keep all other Sections (as well as the National Office and the Editor) advised and up-to-date on any changes in this list.

The accomplishment of Suggestion No. 3 may require a few little fires, but we sincerely hope that the Sections will realize that this will be to their advantage and will cooperate very shortly to such an extent that we can put our matches back in our pocket. As new Sections are admitted to our ever-growing list, and their representatives are listed in the *Journal*, the names should be added to all lists and a letter sent to each requesting that they reciprocate. Your Editor will be glad to help in this respect, for the main reason that when every Section becomes fully informed about the activities and future plans of all other Sections, the present load on the shoulders of Secretary Rimbach and yours truly will be considerably relieved.

4. Finally—and this is 10% for the benefit of your Editor and 90% for the benefit of each Section which is delinquent under the following plan—we recommend that each Section lay out its program for several months or even a full season in advance, arrange for the speakers (the National Office will be able to provide some help along this line in the near future), and forward the entire plan to the *Journal* for publication, either as a whole or as *timely* advance notices. Eventually we hope to publish such a complete list of up-to-date material of this sort that all readers of this *Journal*, whether members of the Society or not, will know about each meeting in advance and can make plans accordingly. (Incidentally, this will be of great benefit to the speakers, too.) Several Sections, notably Charleston, Chicago and Pittsburgh, follow this plan now; we picked these three as examples because they —and no others—sent in their program plans for the entire season in advance.

So there are four suggestions. After this goes to press, we will probably think of some more ideas designed to promote cooperation within the Society, but we will save them and add them to the similar ideas we expect to receive from every (?) Section as a result of this editorial. If all such suggestions are sent to us, we'll build a BIG fire one of these days, and then *watch our smoke!* —RRP.

"A WORD TO THE WISE . . ."

A guest editorial by

JEROME B. McMAHON

The attendance at and the spirit shown in the meetings at Detroit and Pittsburgh have been the source of real inspiration to those of us who are charged with carrying forward the work of the Society and seeing to it that the dreams and aspirations of the organizers are fulfilled. To me, the greatest inspiration arises from the completely spontaneous character of its origin.

I was not connected with its early phases of formation, due somewhat to war circumstances. Many of the organizers, however, have been friends and acquaintances of mine for many years. Through them, and through listening to the discussions, arguments and debates that occurred in the formative meetings, over the luncheon and dinner table, and in hotel rooms far, far into the night, I became convinced that this new Society just being created was going to be not merely another trade or technical organization but a truly representative organization of men who felt that they had a worthwhile contribution to make to the technical progress of the world, and who had found no other effective outlet for the expression of that contribution.

Probably the aspect of this movement which has appealed most to me has been the determination, rather grim in some cases, to keep the control and operation of the Society in the hands of the voting members, rather than delegating it to officers and secretaries. It has been pointed out repeatedly in recent months in the trade and technical journals that the older technical societies had practically completely lost touch with the real wishes and needs of their rank and file members. If the intentions of the organizers of the Instrument Society of America are carried out, this will never happen in our Society, and I trust that there will always be within our ranks a body of members as alert to this need as the organizers have been, and as willing to give unsparingly of their time and effort to assure that the interests of the rank and file members are paramount.

Instrument Developments In Britain*

By **H. B. CRONSHAW**

PART TWO

All this points to one thing, namely, proper training of operatives, and closer contact between manufacturer and user. This is only one example of a rule which applies to all users, and it is one of the tasks of the instrument industry to see that users receive proper instruction in instrument management.

The new instrument I have mentioned is described by its inventors, H. F. Goodman and C. W. Hotchen, as a fast mercury-in-steel thermometer, accurate in all circumstances to within ±0.3° F., and having a total mean lag coefficient of between 0.3 and 0.4 seconds depending on the circulation past the bulb.

The novel feature lies in the construction of the bulb, which is cylindrical but in which the internal space usually occupied by mercury is almost completely filled by a practically non-expansible core. This core is a hollow, evacuated cylinder of Invar, with a few thousands of an inch clearance in all directions between it and the inner wall of the bulb, the clearance being occupied by a film of mercury. The bulb envelope consists of stainless steel having a high and very constant coefficient of expansion. The wall thickness of the envelope is adjusted to be as small as possible yet strong enough that the greatest bursting stress likely to exist is always within its elastic properties.

On a temperature rise the envelope expands, thus increasing the space between itself and the core. The bourdon tube of the gage to which the bulb is connected will therefore assume a less extended position. The action reverses for a drop in temperature. In practice, both mercury and core expand or contract slightly, but their volume change is delayed relative to that of the envelope, thus causing a small overshoot effect in the system. The effects of this overshoot and the delay occur simultaneously and are opposed; they cancel each other except in exceedingly fast temperature changes. Far from being a disadvantage, this provides more safety in operating controllers such as used in flow diversion systems. It will be noted that the stress effects on the bourdon tube gage are the reverse of those of the conventional type.

I might mention that at Reading University, J. E. Caffyn has started a fundamental study of the time-temperature-flow conditions on the H.T.-S.T. system, with special reference to temperature fluctuations. He is using what he calls the electronic switch device, involving resistance thermometers and a cathode-ray oscilloscope, for making multiple measurements of temperature fluctuations.

In the past few years we have seen great changes in the testing of materials as related to quality control. The old boundaries between physics, chemistry, engineering and metallurgy have broken down, and physical methods are entering more and more into laboratory technique. Recognizing the fact that a good physical method is usually both a quick and an accurate method in the determination of properties such as composition and texture, laboratory technicians show an increasing readiness to abandon time-honored, but time-consuming, manipulations.

Quick physical tests enable laboratory control to be more effectively geared to manufacturing operations. Instead of having to await "postmortem" results, only available after the manufacturing operations have been completed, and after any faults or shortcomings have had their effect, and possibly after a consignment has been rejected by the purchaser, rapid instrument methods keep track of any departures from specified values in the raw, intermediate, and finished products and thus enable a correction to be applied immediately. The rapid growth of non-destructive testing is a further indication of the same trend.

With this has come simplification in technique which enables many instruments to be used by semi-skilled persons and, at the same time, a vast improvement in accuracy, sensitivity, and reproducibility, coupled with greater robustness, compactness, and neatness of design.

These circumstances have brought the instrument industry into close relations with two matters which are receiving considerable attention at the present time, namely, the standardization and the marking of industrial materials and equipment. The trend noticeable in all industrial countries toward quality testing as a means of assessing the value and suitability of materials will obviously bring increasing use of testing instruments, and it is therefore necessary for instrument manufacturers to be closely associated with these developments.

Britain, Canada, Australia, New Zealand and South Africa have central standardizing bodies which have developed along similar lines. India and Ireland are taking steps to set up organizations. New Zealand's is the only one which is entirely Government controlled. In Britain the British Standards Institution is recognized by the Government and by industry as the official body; it is an independent body, although the Government contributes financially. The minutes of meetings initiating new work are circulated to standards organizations in Australia, Canada, New Zealand, South Africa and the U. S. A. These arrangements are reciprocal.

Between the wars, at the three Imperial Economic Conferences, recommendations were made to establish Empire uniformity in standard specifications for industrial materials and equipment, co-ordination to be effected by a central body. Discussion was also begun on Certification Marking, whereby assurance is given by an independent authority (excluding the producer) that the goods reach a certain standard. A similar trend toward common standards and proper labelling was shown in the United States when a bill was introduced into Congress in 1939 but it did not become law.

Now, after the war, these matters are being taken up again with renewed vigor, and in fact at the present moment a British Commonwealth Standards Conference is sitting in London. On the agenda are two matters of special interest to which I would like to draw your attention. One is to discuss the general approach to international standardization and the other is to re-open the question of Certification Marking. There is no doubt that both these items have gained much in significance owing to the practice of Government-buying and industrial planning, as well as to a general recognition of the desirability of simplifying types, sizes, etc., and of co-ordinating trade terms and definitions in the English language.

The international aspect of industrial standardization was first brought into real prominence at the Hot Springs Conference in 1943, when attention was drawn to the fact that improvements in the marketing of food and other agricultural products are largely dependent upon the provision of quality standards and an efficient grading and inspection service. Hot Springs recommended the adoption of grade standards which should apply uniformly throughout the world. Waste and confusion would be lessened if containers were also standardized. It would also be a good thing to extend international standards or minimum requirements to drugs, insecticides, fungicides, fertilizers, and other materials, as this would protect agriculturalists from misrepresentation of supplies and would promote purchase of products best suited for particular purposes.

In the following year, 1944, the International Business Conference at Rye, New York, went a step further by proposing a single International Clearing House for information on the establish-nt of quality standards for raw ma- ials from agriculture, fishing, for- ry and mining. In this the co-opera- n of trade organizations should be ured. The International Clearing use should also gather and distribute tistics on production outlook and bable market conditions, and assist country in improving its system of hering information. The Rye Con- ence made a special plea for the , in international trade, of a single tem of weights and measures, pre- ably the metric system, and a ndardization of containers with sonable tolerances.

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*Presented at the first Annual Conference of the Instrument Society of America, William Penn Hotel, Pittsburgh, Pa., Sept. 16-20, 1946.

NOTE: Statements and opinions advanced in papers are to be understood as individual expressions of the authors and not those of the Society.

ncreasing adaption of quality test- as a means of assessing the value materials will obviously bring in- asing prosperity to the instrument ustry. The adoption of Certification rks will also operate in the same ection as it will tend to increase sumer confidence and promote the rchase of products best suited to par- lar uses, thereby not only increas- volume but also variety of products, h corresponding increase in the mber and variety of instruments ded to test them.

But the outstanding feature of this vement, and to my mind the one to especially welcomed, is the turn of ught in the direction of international- tion. If this could actually be achieved would, I feel, go a long way toward aking down political barriers which pede and confuse the free flow of rld trade. Internationally agreed ndards of grading and quality would ce questions of price to the surface, there would be some hope of relat- price to quality on a world basis. we have not progressed far enough render this a practical proposition, difficulties would be laid bare and would at least know where we all nd. Common standards would also plify life for the instrument man y considerably, and it would seem t this Society is in a strong position influence, either directly or indirectly, future course of events.

STEEL RESEARCH

There is no place in the world that uld provide me with a better excuse making reference to steel research n Pittsburgh. Six years of war ught the British steel industry to a ndstill, so far as new developments plant building and research applied ect to steel-making are concerned. w an immense recovery scheme has n launched which seems unique in history of organized research. What amounts to is a network of co- rative research spread over the en- e industry, linking up all existing ources and adding new elements here there, with a strengthening up of ones at strategic points.

The three supporting pillars of this ucture are the Iron and Steel Fede- ion, the Institute, and the Research sociation. Broadly speaking, the deration sees to the efficiency and nomics of the industry and maps its general policy. The Institute looks after technical meetings and publications; while the Association, formed in January, 1945, and directed by Sir Charles Goodeve, promotes and carries out research of common benefit to the industry.

What, essentially, the Association does is to initiate, correlate and organize research. A special objective is to cut down the lag between scientific discovery and its application. It is concerned primarily with background research, techniques and processes. It takes up a position between the Universities and the works' laboratories, relegating fundamental work to the former and technical developments to the latter. Into this framework are drawn certain departments of other research associations, such as the Coke Research Association and the Refractories Research Association, and also more specialized stations set up, or about to be set up, for study of specific problems like corrosion, coatings, metal flow and furnaces.

Evidently, then, this enterprising body has started by thoroughly organizing all existing facilities to their full capacity and now extends the structure in accordance with immediate requirements, and a plan for the future. The length to which it is intended to push this process is shown by diligent search for a mechanism designed to tap all the brains in the industry for ideas and experience, to be pooled for the benefit of the industry as a whole. One step taken in this direction is the setting up of a system of committees and subcommittees, membership of which implies an obligation to apply one's knowledge to the benefit of the whole industry.

One of the departments of the Association is devoted to research on instruments. A recent research of this department has made an important contribution to the measurement of load and torque in rolling mills. This will be further discussed under the heading of Strain and Load Gages.

OPTICAL EQUIPMENT

The enormous number and variety of instruments demanded for military use during the war, which had to be both accurate and robust, and which were subject to quick changes, brought about a great development of the optical section of the industry, and in this, as I have already mentioned, the British Scientific Instrument Research Association played a leading part.

During 1942-4, first quality optical glass was produced at the rate of 273 tons a year, rendered possible only by the providential discovery of an apparently inexhaustible deposit of very pure sand on the Scottish coast. Added to this was the use of plate glass methods, the drive of the Optical Glass Committee at the Admiralty, and the able services of Thomas Martin, Deputy Director of Instrument Production at the Ministry of Supply.

Stimulus also came from the use of Canadian cerium oxide for glass polishing, the use of special optical cements developed by the Research Association to withstand temperature and humidity extremes, and the researches aimed at finding out the best annealing conditions for optical glass, also carried out by the Association. Other new departures are the melting of glass in platinum pots, and the development of a series of rare earth glasses of high refractive index.

One of the military demands was for a variety of accurate and robust graticules. This is a subject to which the Research Association has long given special attention. Even before the war the Association had worked out methods of mass production and, in fact, information on these methods was passed to the United States authorities. However, the urgent request came for graticules of a more robust type than those made by photographic processes, and in response a simple method of manufacturing lead sulphide graticules was quickly devised. This is the most widely used graticule in Service instruments and it has been produced by the tens of thousands.

Then there is the practice of "blooming," for the coating of lenses and prisms with anti-reflection films to secure improved vision and definition, which, as you will recall, was originated by Dennis Taylor in 1892 and developed in the United States. Just before the war a vacuum process was patented in the United States employing metallic fluorides of low refractive index. By arrangement with the Research Corporation of America it was agreed that the Association should handle the process in Britain, but owing to the outbreak of war the details were not received. This necessitated the Association developing its own process and also initiating the industry into the arts of manufacture. There is no doubt that blooming will bring great benefits to the camera and other optical sections of the industry.

I might also mention at this point three other inventions of a similar nature. One is an adaptation of the anti-reflection process to the vacuum production of multiple, transparent films of high reflectivity, by means of which beams can be split with no significant loss of light. This discovery also has an important bearing on photographic equipment and certain other types of instruments. Another innovation worked out by the Association is an anti-rain compound by means of which clear vision is obtained through glass or Perspex under conditions of driving rain or spray. The third is the development of color-filter glasses in connection with the goggles worn by airmen, which have to have special color transmitting and absorbing properties. To these one may also add the production of volatilized aluminum and rhodium mirrors to withstand severe conditions of service, the latter exhibiting complete freedom from tarnishing even when used at sea. It has also been found possible to extend the evaporation technique to the silvering and aluminizing of transparent plastic materials.

It is also worth mentioning one or two advances in the design of optical instruments. At the Admiralty Research Laboratory, R. G. Budden invented a new type of binocular in which objectives and eyepieces are fixed and sealed, and focusing is done by lever-operated prisms. The body is completely waterproof.

New ground has also been broken in dial sights, directors, clinometers and rangefinders. The destruction of Beck's factory in London was a setback to dial sights, but it was overcome, as was also the problem of lubrication arising from stipulated temperature limits of +60° and −50° C. Martin states that a new dial sight is under development at the present time.

Production of tank periscopes, using about 900 tons of glass for prisms, necessitated changes in glass-working. To save labor, metal-grinding and plate glass methods were employed for roughing and polishing molded glass blanks. In producing these blanks, the glass is poured and rolled into thick plates; then cut up and the pieces molded. Periscopes and telescopes were re-designed. An entirely new departure in telescopes at present under development seems likely to revolutionize fire control and gun-sighting in armored fighting vehicles.

As for theodolites, the leading British manufacturers, Cooke Troughton and Simms, Ltd., and E. R. Watts & Son, Ltd., continue to make vigorous progress, shall I say despite the fact that they were pioneers in this field. I understand that the survey units of the American army insisted on British-made instruments.

Speaking of survey work, Scophony Ltd. have invented an ingenious photonymograph, about the size of a typewriter, for producing photographically the names on maps in all the required variations of type, size and spacing. The machine "memorizes" the letters selected by dialing and allocates the appropriate spacing.

Great progress has been made in microscopes, especially in general design and the interchangeability of parts. Indeed, compared with 25 years ago, when German instruments held the field, the change is amazing. One might truly say that a microscope for every conceivable purpose is now available. The beauty of workmanship of the wide range of instruments which I recently examined was most impressive. Last year a joint committee of the Geological and Mineralogical Societies prepared a detailed report of recommendations for the design of petrological microscopes. Several firms are putting out new models based on these recommendations. Finally, it is interesting to note that the Instrument Research Association has developed an objective lens of great light-gathering power, but of simple construction. This "Bracey" lens has been produced in large quantities both in Britain and America. This lens can gather light from a faint distant source and bring it to a brilliant focus. It has a factor of brilliancy of over 50-million. Another invention is an anastigmatic lens for miniature photography and is designed for very fine graticule work. It has a small field of only half an inch, but over this field the definition is theoretically perfect.

To be continued

Editor's Notes

1. 1947 Budgets Requested.

To go around the long way and come in the back door (in other words, sneaking up on this topic of budgets as most people do) we will narrate a little background having nothing to do with budgets, except for the fact that some pretty accurate time-budgeting and some last minute decisions were involved in getting much of the material in this issue of the *Journal* to the readers in time. Considerable of it has grown as it traveled, with Ye Editor on another of his jaunts. The editorial, "Cooperation," appearing in this issue, for instance, was written in Rochester (where we couldn't even *hire* it typed —nights, of course!), re-written between Buffalo and Cleveland, mailed from Chicago and finally printed in Pittsburgh. A chin-fest one noon hour in the cafeteria of a well-known instrument manufacturer in Rochester provided the inspiration for the aforementioned editorial. We've even talked ourself into more feverish activity.

Hence, while in this mood, it was natural that, when we received a last-minute letter from Al Shafer, the chairman of our Finance Committee, requesting us to "jog" all committee chairmen into action, we immediately sat down and wrote the following paragraph, barely making the deadline on this issue. (All this above is merely our way of easing the material in without being too blunt.) So we now quote:

"The Finance Committee is very anxious to start the job of setting up the budget and requests each officer and committee chairman to submit *as soon as possible* an itemized budget to cover the expected activity expenses of his office or committee for the year 1947. As soon as this information is received, the committee will proceed with the job of making up a budget for 1947 covering both capital and operating expenses. A letter has already been sent (by Al Shafer) to all officers and committee chairmen to whom this request is now directed. We hope this paragraph will remind these men to dig out those letters and do something about the requests immediately."

Unquote. And we hope it does some good, Al.

2. Who's Who in the I.S.A.

A somewhat unusual situation arose in preparing the "Who's Who" material for this issue. It is our policy to publicize one officer, one Section delegate and one committee or sub-committee chairman in each issue, and when we dug out our files, strangely enough we had complete information, including photographs, on only one officer, one Section delegate, and one committee chairman. Stranger yet, all three of these men are members of the Chicago Section. Therefore, while we assure our readers that it was not "planned that way," we give the "Who's Who" column over this time to three Chicagoans: (1) J. B. McMahon, Vice-President and Chairman of the Local Sections Committee; (2) Earl C. Rieger, Chicago Section Delegate and Chairman of the Nominating Committee for 1947; and (3) H. C. (Jack) Frost, Chairman of the Papers Committee for the 1947 Conference and Exhibit. Three Chicagoans—three very active men in the I.S.A.

3. Our *Journal* Correspondents

In our editorial, "Cooperation," mention was made of the listing elsewhere in this issue of all Section Delegates, Secretaries, and *Journal* Correspondents. It is this latter group of men who send us most of the material which we edit and otherwise prepare for publication in these columns. We make special mention of these men at this point for two reasons—the first is that this is the first formal introduction of these workers to the Society in general. Gentlemen, meet each other! The second reason is to urge every member to help the Correspondent representing his Section by seeing that he has news and other information to send in each month. If your Section is not represented well enough or often enough in the Section News Department of the *Journal*, get after your Correspondent and see that he gets more and better material to send in. Here's where cooperation within a Section will pay big dividends.

4. Chicago By-Laws Available

The Chicago Section appointed a By-Laws Committee early in the season to re-write the by-laws of the old Chicago Society for Measurement and Control so as to conform with the National Constitution. The job has been completed and the new articles, now known as the "By-Laws of the Chicago Section of the Instrument Society of America," have been printed and will be distributed the first of March to all members.

The reason for mentioning this in this column is that several Sections have requested copies of the by-laws of other Sections, including Chicago, and we take this opportunity of encouraging such exchange of information. Many new groups, especially those in the early stages of formation, can benefit greatly by studying the by-laws of well-established Sections. We urge anyone who is interested to write to Secretary Ertsman of Chicago or to the Secretary of any other Section and ask for copies of the by-laws of that Section. We can promise that in most cases the material will be in the return mail to the writer.

5. Our Cartoonist

Another feature has been added to the *Journal*—and when you chuckle over it (yes, our first cartoon) think of "Gene" Mitchell, a member of our

arleston Section. Mitchell, as he ographs his cartoons, is a member Ralph Webb's Instrument Division the Carbide and Carbon plant in arleston. His flair for drawing ught him to our attention, and our rtoon-less *Journal* (unusual now- ys) brought us to his attention, so inevitable happened and we see the ult in this issue. "Gene" will con- bute regularly and we hope you will oy his brain-children.

THE NEEDLE POINTS TO—

***Charleston*—for a Section News re- rt that makes the most interesting ding of any we have yet seen.**

***New Jersey*—for an innovation in tion News material (photographs). D. NOTE—why not something similar m other Sections?)**

***Oak Ridge*—for the biggest improve- nt in style and detail, and for pro- m information which is the furthest advance of any yet received.**

Perhaps we need a lot of little dles this time, because so many tions submitted excellent material. norable mention, at least, should go Detroit, New York, Pittsburgh, thern Michigan, Tennessee and shington. However, eight Sections re not even heard from this time. We ll welcome any suggestions as to how go about getting at least something, ether timely or not, out of the de- quent Sections. How about it, fellows?

—R. R. PROCTOR

General News

MINATING COMMITTEE ACTIVITIES; ST, PRESENT AND FUTURE

n 1946 the Nominating Committee con- ed of R. D. Webb, Chairman, J. E. mbrill, W. A. Sachse and E. C. Rieger. secure a slate of candidates for the of- s to be filled at the September meet- of the Board of Directors, this commit- provided forms and requested each Sec- to recommend nominees. On August 6, 6, the committee met in Pittsburgh to ulate the results as of that date, and its l meeting was held on Saturday, Sept. just prior to the meeting of the Board Directors during the "Instrumentation Tomorrow" Conference in Pittsburgh. final slate was prepared at that time.

n 1947 it is planned to follow a similar rse unless a more suitable program de- ps. The aims and objectives of the nom- ing committee are, of course, to present late of nominees for national I.S.A. of- s who represent the country generally who are qualified to perform the duties their offices. Any individual suggestions likely nominees, or methods of selection, be very welcome.

ctive work on this committee for 1947 not yet started, although by the time appears in print, some preliminary k will have been done. Other members this committee include Paul Exline ttsburgh) and J. C. Peters (Philadel- a).

—E. C. RIEGER, *Chairman*

NANCE COMMITTEE ORGANIZED

t the meeting of the Board of Directors the I.S.A. in New York, December 4, 6, the writer was appointed Chairman the Finance Committee. Other members this committee are President C. O. Fair- d, Executive Secretary Richard Rimbach Treasurer H. E. Ferguson.

his committee held its first meeting im- diately after the meeting of the Board Directors on Dec. 4, with the other mem- s of the Executive Committee sitting in, conducted a general discussion of the blems facing the new Finance Committee rranging a budget for 1947. The budget be the first consideration of the committee, and requests have been sent to all officers and committee chairmen for itemized budgets covering the year's activities of each.

The following motion was moved, seconded and unanimously approved: "Richard Rimbach, Executive Secretary, and Hugh E. Ferguson, Treasurer, are hereby authorized to incur current expenses of the Society until other arrangements are made."

On January 2, 1947, the National Treasurer (Ferguson) opened a set of books which should give a complete accounting of all funds on a daily basis. The necessary information is in his hands at the present time and we are quite confident that this system will give us all the necessary information to complete an audit at any time and further give a daily bank balance of the National I.S.A. treasury. This account has been opened with the Livestock National Bank in Chicago.

—A. H. SHAFER, *Chairman.*

1947 CONFERENCE PROGRAM NOW BEING ARRANGED

The Papers Committee for the 1947 Technical Conference has arranged a program which includes seven sessions. These are in addition to the educational sessions which will be offered at the same time. The committee is anxious to attract speakers of the highest caliber on subjects which will be both interesting and educational to the membership of the Society. In order that the members may be acquainted with the nature of the program which has been selected, the names of the sessions and a brief resume of what they are to cover is given below:

Plant Practices

Installation, maintenance and repair of instruments, and organization of, and methods used by, modern instrument departments.

New Instrumentation Developments

Unusual or new application of measuring devices or automatic controls with emphasis on problems which necessitated developments and results achieved.

Inspection and Gaging

Inspection and gaging practices and quality control by various methods of instrumentation.

Process Control

Application of instrumentation to processes, with emphasis on reasons why a particular control system was selected for a particular job, and results obtained.

Research and Testing Instruments

Application of new research or testing instruments to specific problems, preferably where broad usage in similar or unrelated fields may be possible.

Chemical Concentration Measurement and Control

Modern methods of measuring continuously such variables as pH, electrolytic conductivity, density, viscosity, and other chemical concentration variables. Peculiar problems introduced through application of automatic control with such variables.

The emphasis of the entire program will be on the application of instrumentation to specific problems rather than detailed descriptions of devices used for these purposes. One program of special interest already definitely scheduled is the "Demonstration of the Principles of Automatic Control" by Mr. G. F. Akins of Eastman Kodak Company. This was presented at the 1946 Conference in Pittsburgh and brought in so many requests for a repeat performance at the 1947 Conference that the Papers Committee has already arranged for this presentation to be a part of the program. Because of its fundamental nature, it was felt that this presentation would bear repeating, many times, in fact, without losing its appeal or educational value.

Other papers have been solicited, and some have been submitted already. These are under consideration at present. However, suggestions from the entire membership are requested. Please address comments to Mr. H. C. Frost, Corn Products Refining Company, Chemical Division, Argo, Illinois, or to other members of this committee, namely:

Harry Barnett, Powers Regulator Company, Chicago.

Nelson Gildersleeve, General Electric Company, Schenectady.

Don Bergman, Universal Oil Products Company, Chicago.

Prof. Richard Jones, Northwestern University, Evanston, Ill.

J. B. McMahon, Republic Flow Meters Company, Chicago.

—H. C. FROST, *Chairman.*

THREE SECTION APPLICATIONS RECEIVED AND APPROVED

Since December first, 1946, the National Office has received applications for Section charters from three organizations. According to the Constitution and By-Laws of the I.S.A., Article X (Chartering of Sections) states that "upon approval of a petition by the Executive Committee, the Executive Secretary shall issue the charter." Action upon the three petitions on the part of the Executive Committee was favorable.

The three groups desiring Section status are:

1. The Eastern New York Instrument Society. (President, Nelson Gildersleeve, General Electric Company; Secretary, William J. Claffio, Winthrop Chemical Co.)
2. The Indianapolis Technical Instrument Society. (President, W. H. Sisson; Secretary, Morris R. Underwood.)
3. The Instrument Society of Aruba. (Names of officers not submitted, but membership is about 25 at present.)

The Eastern New York Instrument Society has members from Schenectady, Albany, Troy and other cities in that vicinity, and requested its charter issued in the name of the Eastern New York Section of the I.S.A. The Indianapolis Technical Instrument Society wishes to be known as the Central Indiana Section of the I.S.A. The Instrument Society of Aruba desires status as the Aruba Section of the I. S. A.

—R. RIMBACH, *Exec. Sec'y.*

Official Department

ABSTRACT OF THE MINUTES OF THE MEETING OF THE BOARD OF DIRECTORS OF THE INSTRUMENT SOCIETY OF AMERICA, DECEMBER 4, 1946—NEW YORKER HOTEL, NEW YORK CITY

1. The following members of the Executive Committee in addition to President Fairchild were present: Carl Kayan, H. Barnum, J. B. McMahon, Hugh Ferguson, A. F. Sperry, and Richard Rimbach. Absent R. H. Munch.

2. The roll call of the Board of Directors indicated a quorum was present.

Name	*Section*	*Votes*
R. D. Webb	Charleston	98
H. C. Frost	Chicago	198
A. H. Shafer (proxy)	Cleveland	71
A. H. Shafer (proxy)	Cumberland	25
H. H. Barnum	Detroit	53
H. Moore	New Jersey	125
H. L. Hildenbrand	New York	119
H. V. Fisher	Oak Ridge	56
M. H. White	Philadelphia ...	204
A. H. Shafer	Pittsburgh	143
H. Moore (proxy)	St. Louis	61
H. Barnum (proxy)	South Michigan.	30
W. Wildhack	Washington	109
H. Barnum (proxy)	Wayne County..	36

3. Mr. F. A. Murray (Powers Regulator Company) member of the Instrument Industry Advisory Committee was present, also the following guests: Wilkins (N. Y. Board of Trade), Todd (Philadelphia Convention Bureau), Dawes and Arata (Washington Board of Trade), Tanner (guest of Harry Moore), Miss Dushkis (guest of Sperry), Batcher (N. Y. Section), Corey (N. Y. Section), Farnham (N. Y. Section), Robinson (Chicago Section), Trapnell Philadelphia Section), Johnston (Philadelphia Section), Mouzon (Philadelphia Section), Bertram (Philadelphia), Rogers (Philadelphia Section), Wood (Philadelphia Section), Behar (Pittsburgh Section), Exline (Pittsburgh Section).

4. The meeting opened after dinner. There were lengthy discussions as to whether the Convention of 1948 should be held in New York, Philadelphia or Washington, D. C. Representatives of the Convention Bureaus of the three cities were present, who gave the Board of Directors data concerning accommodations and facilities in the respective cities.

5. President Fairchild read the following letter from the Instruments Publishing Company:

Mr. C. O. Fairchild, President,
The Instrument Society of America,
114-74 178th Place,
St. Albans, L. I., N. Y.

Dear Owen:

In reference to the arrangement between the INSTRUMENT SOCIETY OF AMERICA and the INSTRUMENTS PUBLISHING COMPANY, I would appreciate your advising me if the following would be satisfactory to you and the Executive Committee.

1. The INSTRUMENTS PUBLISHING COMPANY will send a copy of each issue of INSTRUMENTS to each I.S.A. member in good standing.

2. The INSTRUMENTS PUBLISHING COMPANY will provide a suitable masthead for the I.S.A. Section as well as mention on the front cover of INSTRUMENTS.

3. The INSTRUMENTS PUBLISHING COMPANY will furnish the proofreading and layout (not editing) of the I.S.A. Section of INSTRUMENTS.

4. The INSTRUMENTS PUBLISHING COMPANY will pay the I.S.A. for the editorial work on the I.S.A. Section of INSTRUMENTS.

5. The INSTRUMENTS PUBLISHING COMPANY will provide a maximum of 8 pages for the I.S.A. Section for six months, after which time adjustments will be made to meet requirements.

6. The INSTRUMENTS PUBLISHING COMPANY will pay for all engravings which appear in the I.S.A. Section.

7. The INSTRUMENTS PUBLISHING COMPANY will prepare and maintain the mailing list of the I.S.A. without charge and will carry out the necessary addressing without charge.

8. The INSTRUMENTS PUBLISHING COMPANY will furnish the necessary office space to the I.S.A. without charge.

9. The INSTRUMENTS PUBLISHING COMPANY will refund to all members the amount of their unexpired subscription when this agreement becomes effective.

I. The Instrument Society of America will pay the INSTRUMENTS PUBLISHING COMPANY $1.00 per member per year for a subscription to INSTRUMENTS.

II. Each member of the I.S.A. will sign a statement that one dollar of his membership dues is for payment of a subscription to INSTRUMENTS. This is necessary for the second class mailing privilege.

III. The Instrument Society of America will appoint the Editor of the I.S.A. Section of INSTRUMENTS.

IV. The Editor of the I.S.A. Section of INSTRUMENTS will furnish to the INSTRUMENTS PUBLISHING COMPANY the editorial material for the I.S.A. Section by the 20th of the month preceding the month of publication (for example, material for November must be received by October 20th). The editorial material is not to include material already included in INSTRUMENTS as feature sections.

V. This agreement is to be operative for two years with the privilege of cancellation by either party on 3 months notice.

Sincerely yours,
Richard Rimbach, President
INSTRUMENTS PUBLISHING
COMPANY

Fairchild stated the Executive Committee had approved this arrangement and would like to have the approval of the Board of Directors.

CLEVELAND REGIONAL MEETING

The Spring Regional Meeting of the I.S.A. will be held at the Hotel Carter, Cleveland, Ohio, on April 4, 1947. The Cleveland Section is arranging a very interesting program consisting of morning and afternoon sessions with two speakers at each of these sessions; dinner and entertainment in the evening.

While it is impossible at this time to print the details of the complete program, the completed program for the meeting and advance registration will be sent out shortly. In addition to the technical program on April 4th, a meeting of the Educational Committee will be called by Chairman Teare on April 3rd, and the Board of Directors will meet on April 5th. The Board of Directors meeting will be preceded by an Executive Committee Meeting.

Place these dates on your calendar.

After some discussion the motion was made, seconded and carried.

6. President Fairchild reported that the Committee appointments were approved by the Board of Directors. Replies were received from nine sections, all these having been approvals.

7. The Chairman of the Sections Committee, J. B. McMahon, reported on the possibility of the I.S.A. joining with the Texas A. & M. College in sponsoring their annual engineering conference on instrumentation.

8. Moore moved that the Board of Directors delegate the Sections Committee to contact this Texas A. & M. group and see if some method can be worked out to cooperate to our mutual benefit. Also, that a letter be written to Prof. Murdock offering our assistance and support. Motion was seconded and carried.

9. After a discussion of traveling allowances for delegates and members of the Executive Committee, it was moved that President Fairchild appoint a Committee which is to include the Chairman of the Finance Committee, which will investigate and make recommendations of the proper methods of helping to finance the expenses of delegates and National officers to meetings of the Executive Committee and the Board of Directors. This motion was seconded and carried. The Committee was appointed: A. F. Sperry, Chairman, A. H. Shafer, H. E. Ferguson, J. B. McMahon and H. H. Barnum.

10. The Treasurer's Report was read. (Appears elsewhere in this issue).

11. Sperry reported on the Chicago Conference and Exhibit. Robinson, Exhibit Committee Chairman, and Frost, Chairman of the Papers Committee, reported.

12. In reference to the 1948 Conference and Exhibit, Kayan, Moore, White, and Wildhack extended invitations from their sections, and described the advantages and attractions of New York, Philadelphia, and Washington, then the Board of Directors voted unanimously to hold this in Philadelphia.

13. New Committee Appointments—Fairchild: "Al Shafer has accepted appointment as the Chairman of the Finance Committee. The other members of the Committee will be Ferguson, Rimbach, and Fairchild.

"Wildhack has accepted the chairmanship of the Committee on Committees. The purpose of that Committee will be to analyze the authority and the responsibilities and the proper actions of the Committees and report to the Board of Directors with a definition of what each Committee must do."

14. Barnum moved, "There shall be a meeting of the Board of Directors three times a year, one of which will be approximately one month before the annual meeting, the second in December, and the third in the Spring." Seconded and carried.

15. Members of the Board were asked to approve an emblem. A motion was made to have the Membership Committee make a decision on the emblem and make arrangements to have it made. Seconded and carried.

16. Wildhack made the motion: The Executive Committee with Shafer as Chairman of the Finance Committee be authorized to spend Society funds until such time as a budget has been set up. Seconded and carried.

17. Meeting adjourned at 1:00 A. M.

—R. RIMBACH, *Exec. Sec'y.*

TREASURER'S REPORT—THE INSTRUMENT SOCIETY OF AMERICA

(Presented at Meeting of Board of Directors, New York City, December 4, 1946)

A formal National Society account has been opened in the Livestock National Bank of Chicago—and to date contains

November 12, 1946	$1076.28
November 18, 1946	686.80

This money represents the Charter Fees of the South Texas and Southern Michigan Sections—and either part or full dues of 191 members; 20 Associates and 3 Students from ten sections. This represents only moneys received by the Society since installation of the present officers.

" . . . but all it needs is a new pen point . . ."

From the above deposits, to date, four disbursements totalling $297.50 have been made—$260.00 to the Baltimore Section, 12.50 for a bond for the Treasurer, $24.00 for new membership cards, and a $1.00 refund on a membership application. So that the Chicago account now contains a balance of $1,465.58.

In a Pittsburgh bank, under the care of the past Treasurer, there is a balance of 1,558.61—representing the residual of collections of dues and donations during the past year after payments of the expenses of the National Office. I have not received an itemization of the receipts or expenditures because Mr. Clarke Fry is having difficulty in closing his accounts due to outstanding checks totalling $592.71 which have not been cashed. The Society's account in Pittsburgh thus has a net size of ,965.90.

In another Pittsburgh bank, under the care of Mr. Al Shafer, there is the account representing moneys received by the Society from the 1946 Conference and Exhibit. Mr. Shafer advises that, as soon as all expenses have been paid, the residue will be turned over to the National Treasurer—and that the amount involved will be about $8,500.

NOTICE

A meeting of the Subcommittee on Thermocouples and Thermocouple Wire Extension of the Standards Committee will be held at 10 A.M., February 25 and 26, 1947, at the Leeds and Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Discussion will be on color coding and insulation specifications.

Thus to recapitulate, the assets of the Society today may be considered to be

Chicago Account	$ 1,465.58
Pittsburgh Account	2,965.90
Exhibit Account	8,500.00
	$12,931.48

In addition, there is an indeterminate amount in a small account in the Bank of Nova Scotia that has been just opened to cover transactions involving the Canadian Sections.

To be complete this report should provide statements of indebtedness, accounts payable, and estimates of expenses that will be applicable to the above indicated assets of $13,000. It will not be possible to do this until the contemplations of this meeting are concluded and the newly appointed Budget & Finance Committee has a chance to meet and act.

—H. E. Ferguson, *Treasurer*

Who's Who in the I. S. A.

EARL C. RIEGER

As one of the spark-plugs of the Instrument Society of America, Earl Rieger has been, and still is, one of the most active, influential and respected men in the organization. Going back even further, he was active in the formation and organization of the Chicago Society for Measurement and Control in 1940 and was the first President of this group. With this background, it is only fitting that he be elected Chicago's Delegate to the Board of Directors of the I.S.A. in 1946.

Earl is a graduate of Armour Institute of Technology (now Illinois Tech.) in 1922 in Mechanical Engineering. As Plant Engineer of the Gas Power Engineering Department of International Harvester Company, he is in charge of maintenance (including the instrument section) and design or purchase of testing equipment and facilities.

During the formative years of the I.S.A. as a national organization, he served as chairman of one of the organizational meetings (in Chicago) and served on the Nominating Committee which prepared the slate of national officers now heading up the Society. Now, in addition to being Chicago's Delegate, Earl is the 1947 Chairman of the Nominating Committee. (A brief report of this committee's aims and activities appears elsewhere in this issue.)

Earl and his wife, son (18) and daughter (15) live in Western Springs, Ill., where he is active in community functions and where he indulges in his hobby—symphonic orchestra work—when possible. He is a member of the S.A.E., the S.E.S.A., the Chicago Section of the I.S.A., the Ordnance Association, and the American Legion.

JEROME B. McMAHON

J. B. McMahon, better known as "Mac," is one of the four vice-presidents of the I.S.A. A graduate of Carnegie Institute of Technology, Mac holds the position of Application Engineer with Republic Flow Meters Company, Chicago, Ill. During past years, he has served as Sales Engineer with National Supply Company, Tulsa, Okla., as Sales Engineer, District Manager and finally Manager of the Controller Division of the Foxboro Company, Foxboro, Mass., and more recently, Administrative Head of the Instrument Department of the Kellex Corporation, New York City. This latter assignment was carried out while on leave from Republic.

Mac is a member of the A.S.M.E., A.P.I. and the Chicago Section of I.S.A. Besides being a vice-president of the I.S.A., he is also chairman of the Local Sections Committee which, largely through Mac's efforts, will soon bring several new groups into the organization.

He is married, has three children (all girls), and lives at 243 Linden Ave., Wilmette, Ill. Hobbies include golf (when feasible), music and reading.

H. C. FROST

"Jack" Frost (so called for obvious reasons) has presented many technical papers himself and has wide acquaintance among instrument men, especially among the process industries. Logically enough, therefore, Jack has been appointed chairman of the 1947 Conference Papers Committee. This committee, a sub-committee of the 1947 Conference Committee under the chairmanship of Albert F. Sperry, is charged with the task of securing speakers for the technical sessions of the Conference and Exhibit to be held in Chicago this coming September.

Jack, who was either too modest or too busy to give your Editor much information concerning himself, is Assistant Director of Engineering, Chemical Division, of Corn Products Refining Company at Argo, Ill. He is a member of the Executive Committee of the Chicago Section, and otherwise very active in the affairs of the Chicago group.

A comprehensive report of the activities of the Papers Committee to date has been prepared by Mr. Frost, and appears elsewhere in this issue. This article is of particular and timely interest to all members, and special attention is hereby called to it.

Section News

BALTIMORE

Fifty-three members and visitors of the Baltimore Section assembled at the Engineers Club of Baltimore on Friday, January 1947, to hear a very interesting and enlightening talk on the subject of "Gas Analysis—Its Measurement and Control."

Mr. J. F. Maienshein, President of the Section, conducted a short business meeting and then presented Mr. H. P. Rodgers, who in turn introduced the guest speaker for the evening, Mr. F. R. Davis of the Davis Emergency Equipment Company.

During his talk, Mr. Davis captured and held the interest of those present by highlighting his topics with demonstrations of several instruments, among which were the Combustible Gas Indicator, the Thermal Conductivity Instrument, and the Davis atometer.

A discussion period followed with Mr. Davis answering many and varied questions for the members and visitors; later, refreshments were served, closing the meeting.

—Kenneth R. Miller, *Corr.*

CHARLESTON

It took a burned-out bulb in a slide projector to stop the January 6, 1947, meeting of the Charleston Section—but after all it was 11:30 P.M. and the meeting had been called to order along about 7:30 P.M. at the Kanawha Hotel. Several members lingered longer too—such was the interest. No wonder! Just take a look at the program:

1. Mr. R. D. Webb reported as National Delegate to the New York meeting and gave us a good report—what else could you call it with the ISA reported as "rich" and "growing rapidly all over the country." Many took his warning seriously about getting reservations in for the Chicago meeting. Just think, it's not until next fall but now is not too early to make definite plans.

2. Mr. Charles Holz, one of the organizers and first president of the Charleston, W. Va., Section gave us a resume of ISA accomplishments and advantages as an observance of the first birthday of ISA. He pointed out that we had grown steadily and rapidly, that we had the privilege of associating with men of all phases of the Instrument business both locally and at the national meetings such as the Pittsburgh conference. "Receiving Instruments Magazine as part of the ISA membership is worthy of mention but also it should be observed that technical books can be bought at a discount through the national office," he continued.

Sounds all right so far doesn't it? Well, the clock was laughing at us as it raced madly around the dial.

3. Now one hundred fourteen men gave close attention when President Lorig introduced the first speaker, Mr. V. V. Tivy of the Foxboro Company. With illustrating slides Mr. Tivy first outlined and discussed

their Model 40 controllers, pointing out the similarity and the improvements that had been made. Some few new Model 40 controllers have been showing up around and everyone listened intently. The bulb in the projector burned brilliantly as Mr. Tivy left the Model 40 and very cleverly discussed the derivative control function or in Foxboro language "Hyper-Reset." Some of the weaker members began to weaken but they shuffled and got a new grip on the edges of their seats. The clock was ahead when Mr. Tivy showed his last slide and answered a few questions.

4. After a few minutes of intermission along about 9:30 P.M. Mr. Lorig presented the President of the Pittsburgh Section of ISA, Mr. Sam Prince, an old friend of ours, for a bow, and Mr. Satow, Mr. Humphreys, and Mr. Stahelin, engineers from Imperial Chemicals Industries, Ltd., of England, who were visiting with us.

5. Mr. E. D. Haigler, Manager of the Application Division of the Foxboro Company, was next introduced to the group. Ed said right off that we had an endurance contest, but it took no effort to listen to the account of his trip around Europe after VE day. He was sent with three others from the Instrument Industries to investigate Nazi instrumentation as they saw fit. Ed had over three hundred slides, and good ones too, from his travels.

Then it happened—all went dark. After checking all connections of the extension cords we found that the bulb had burned out—and just as Ed had started up an eight-mile mountain in Switzerland on a special train. Such is life but the clock was smiling 11:30 P.M.

Thanks a lot Mr. Foxboro for a fine evening and two good speakers!

The meeting was thus adjourned until the next month, when, on Feb. 3, Leeds & Northrup present "Application and Fundamentals of pH and Conductivity Measurements."

On Monday, March 3, Mr. Lyman Allen of the American Viscose Company, will present "Fractionating Column Control Considerations."

—CARL CAVENDER, *Sec'y.*

CHICAGO

Monday, March 3, 1947 — "Instrument Maintenance Problems," by Mr. A. Kyle, Claud S. Gordon Company, Chicago, Illinois.

CUMBERLAND

The Cumberland Section, Instrument Society of America, held a dinner and technical meeting, Friday, December 20, at the Queen City Hotel.

The speaker for the technical meeting, Mr. Charles A. Packard, Chief Engineer for Struthers-Dunn, Inc., gave a very interesting talk on "The Relay as an Instrument Auxiliary." After the meeting Mr. Packard showed some very interesting electric relays he developed as a pastime and a hobby.

The next meeting will be held January 28th, 1947; arrangements for a speaker are not complete.

—H. E. BISHOP, *Corr.*

DETROIT

On Monday, December 16, some forty hardy souls braved snow storm and slippery streets to hear Mr. Donald T. Street of the Scientific Bureau, Bausch & Lomb Company address us on "Optical Instruments in Industry." The speaker gave a clear description of the human eye as an optical instrument and stressed its attendant limits, particularly those of resolving power. As an example of the role that optics play in the field of measurement, Mr. Street mentioned that the human eye can detect alignment of vernier lines to one-hundredth of the minimum distance between which two distinct points can be resolved.

The talk was illustrated by slides of the optical systems discussed and included pictures of optical industrial instruments of both domestic and foreign manufacture.

Several of the many questions asked after the talk originated interesting discussions such as a lively argument on the possibility of light having mass.

MEMBERS OF ARUBA SECTION, I. S. A.:

***Seated, first row, left to right:*—E. H. Pfeffer, Penna.; J. L. Lopez, Okla.** (Secretary); **D. Fryback, Indiana; E. J. Hillstead, Kansas; A. Halpert, Hungary; W. O. Weber,** Penna. ***Second row, left to right:*—A. E. Krottnauer, N. C.; W. A. Koopman, Holland** (Treasurer); **C. L. Kasson, Mass.; M. A. Davidson, Mass; L. L. McGrew, Wyoming; G. Echelson,** Texas; **A. S. MacNutt, Calif. (President). *Third row, left to right:*—L. N. Crippen,** Missouri; **M. R. Holly, N. J.; E. S. Stanley, Mass.; W. F. Hughes, N. Y.; J. N. Faucett,** Illinois; **P. E. Jensen, Denmark and N. Y.**

Not in the picture were: G. A. Janson, Mass.; H. de Paauw, Holland; E. L. Wilkins, **Indiana.**

The girl is a pencil sketch on the wall of the Cabana where we held our meeting.

These members of the Instrument Society of Aruba are made up of the foreign staff em**ployees of the Instrument Department of the Aruba Refinery operated by the Lago Oil & Transport Co. Ltd., a subsidiary of the Standard Oil Co. of New Jersey.**

They are responsible for some 6,000 units of of instrumentation equipment which includes **recording and controlling instruments of all makes.**

After the lecture a tour of the Ethyl Research Corporation's Dynamometer Laboratory and Instrument Section was conducted by members Emil Gillig and Jack McCullough.

The continued interest in the demonstration part of the monthly meetings was shown again in the attention given to the display of Carson Electronic Micrometers.

Since this meeting was the last one to be held at the Ethyl Laboratory, doughnuts and coffee were served during a little "farewell" party which rounded out a pleasant and interesting evening.

On Monday, January 27, our speaker will be Mr. Theodore A. Cohen, President of the Taco West Corporation, who will speak on "The Electronic Phases of Automatic Control Apparatus and Special Problems in Pyrometry." The January Demonstration will feature industrial controls and safety appliances of the Industrial Instrument Supply Company, with Mr. Charles Sherwin in charge.

The February 24th meeting will bring to us Mr. M. C. Tate, of the A. H. Emery Company, who will discuss "The Tate-Emery Cell," and Mr. A. Heise, of the Heise Bourdon Tube Laboratory, describing "Precision Bourdon Gages."

—SIEGMUND KULKA, *Corr.*

GULF COAST

(Quoted from a letter addressed to the Editor on January 7, 1947)

"Dear Sir:

This is to inform you that election of officers of the Gulf Coast Section was held on December 17, 1946, with the following results:

President	T. H. Pierson
Vice President	O. L. Weir
Secretary-Treas	R. L. Nichols
Program and Publicity Chairman	R. M. Howe

The above officers will be installed at a dinner meeting to be held January 21, 1947, in the Mirror Room of Hotel Beaumont.

We will mail you a copy of the By-Laws and Constitution of this Section which were approved at our December meeting.

Memberships are picking up and we ar looking forward to a very successful year.

Yours very truly,

—R. M. HOWE

NEW JERSEY

There were very few vacant seats at th January meeting of the New Jersey Sectio at the Essex House in Newark. Walte Wills of the Brown Instrument Compan spoke on Electronic Pyrometry. His tal was very interesting and well received a evidenced by the comprehensive discussio period which followed.

Mr. Wills divided his talk into three parts the first of which was devoted to the various means of converting D.C. voltages t A.C. voltages. Some twelve differen methods of accomplishing this conversio were illustrated by slides. The second portion of the speaker's presentation was devoted to a blackboard discussion of ho to apply electronic recording instrument to special applications. He used, as an illustration, the problem of recording light intensities from a photo-cell preamplifier. Th importance of considering interconnection between the electronic recorder and preamplifier was brought out as well as a consideration of range of the instrument, inpu impedance, and maximum voltage applied t the electronic instrument.

The third portion of the talk was devoted to a presentation of several new devices that are used with electronic recorders These devices were used in an experimenta demonstration of such effects as radiatio and emissivity. A demonstration was als given of a supersafe alarm system for us with electronic instruments.

As reported in this space last month our February meeting is being devoted t a discussion of the problems of educatio of instrument men. Mr. John Kelly o Calco Chemical Co. has prepared the program which will be handled in the form of a panel discussion. He will be assiste in the presentation by Prof. Paul S Creager of Rutgers University, Mr. Fred S

Snapshot taken by Past-President Dick Roberts at recent joint meeting of New York and New Jersey Sections at Men's Faculty Club, Columbia University. Seated left to right: Sidney Baran, Vice-president, New Jersey Section; V. L. Parsegian, speaker of the evening; Prof. Carl Kayan, President, New York Section; Herb Close, Secretary, New Jersey Section.

h of Arthur G. McKee Co., and Mr. M. J. dden of Brown Instrument Co.

Prof. Creager will approach the subject m the standpoint of college instruction. Rich, because of the success of his -the-job" training course set up at Oak dge, will discuss the subject from this gle. Mr. Ladden, who has had wide exience in training instrument men, will r the manufacturer's viewpoint on the blem. As the education of men entering field of instrumentation is of vital erest to most men in industry, we look ward to a very lively and interesting cussion.

The Executive Committee of the N. J. tion has been interested for some time establishing a program of subjects that uld appeal to the electrical people. The gram for the March meeting is the ret, and a talk by Mr. Arthur Liebscher RCA at Camden, N. J. has been eduled. Mr. Liebscher will talk on pplication Technique In The Use of The thode Ray Oscilloscope."

We are pleased to welcome as new mems of the N. J. Section:

F. S. Rich—Arthur G. McKee & Co.

Xavier De Haas—Reilly Tar & Chemical

James W. Bennett—Energy Control Co.

Stanley L. Rimgail — Congoleum-Nairn,

John W. Post—Pyrometer Service.

The Program Committee has just comted arrangements for the June meeting, ich will be an inspection trip through rts of the Calco Chemical Co. plant at und Brook, N. J. Further plans will be nounced later.

—George R. Feeley, *Corr.*

NEW YORK

The New York Section of I.S.A. held its cember meeting on Wednesday evening, 18th, at the Men's Faculty Club, Colum University, New York City. Forty-seven mbers and guests were present for sup, with six additional members coming er for the meeting.

At 8:00 o'clock, Pres. Kayan called the eting to order and opened with the read of the minutes of the last meeting. The airman of the membership committee. Mr. ggerty, made a report on membership owth. The vice-president, Mr. Hildenand, read an interesting and amusing eudo report and the treasurer, Mr. Cort, announced that the section was still vent. Mr. St. Clair, chairman of the minating committee presented the nomtions his committe wished to make. Since further nominations were made from the or, the nominations were closed. The siness meeting adjourned at 8:15.

After a five minute recess to allow for rrangement of the chairs, President yan introduced the speaker for the eveg, Mr. C. B. Moore of Moore Products who presented a very interesting paper titled "The Solution of Instrumentation Problems by the Pneumatic Null Balance Method."

Mr. Moore using illustrated slides, described the development of the pneumatic null balance instrument from a simple indicator and regulator through various possible arrangements into process control. The possibilities available in process control, that is, throttling, reset and derivative control with their pneumatic circuits, were explained. He emphasized the fact that the system has few mechanically moving parts, and thus provides rapid response, lack of wear, and absence of friction.

Following the talk, several questions were answered and then the members gathered around the speaker to examine the equipment and discuss problems.

The meeting closed at 10:00 o'clock.

—Charles D. Corey, *Secretary*

OAK RIDGE

The regular January 7th meeting of the Oak Ridge Section of the Instrument Society of America featured Mr. Ronald Reamer of the Taylor Instrument Companies of Rochester, New York, as guest speaker. The dinner portion of the meeting started at 7:00 at the Grove Hall, followed by the regular meeting.

Mr. Reamer spoke on the subject of "Time Cycle Controllers and Coordinated Instrumentation." His talk did not deal directly with the instrumentation installation at any of the Oak Ridge plants: however, automatic controllers, and continuous control especially, is a topic of profound interest to most everyone working at these plants. Continuous control today makes it possible for American industries to produce quickly and efficiently products which were once considered impossible to produce by this method. Instrumentation is the nerve center of uranium-235 production.

The instruments referred to are those meters, valves, and such linked into complex control panels, that mystify their own operators, balk even the understanding of engineers and almost terrify the layman. More specifically, they are those meters that automatically control high-speed continuous-flow processes in the chemical, oil, and other industries. As such, they rival the continuous assembly lines as America's greatest contribution to mass production. It was during the depression, in fact, when many assembly lines were grinding to a halt, that U. S. chemical engineers finally mastered the tools and materials to make possible the continuous-flow process. Mr. Reamer worked for the company who played a major role in mastering these tools and material to make possible the continuous flow process. Stage by stage, they brought out every step of a fast moving operation in liquids, gases, or semi-fluids under the control of central boards of highly sentient instruments.

Mr. Reamer's talk dealt primarily with the moisture processing of tobacco with steam and water in a vacuum. He approached the control problem involved and showed how a time cycle controller was connected with all the instruments necessary to make the process workable. The opening and closing of all valves for steam, water, vacuum, mist, etc., was discussed on a cycle control diagram thereby showing the relationships of each as either independent, dependent, or non-related. It was evident from the explanation that a number of time cycle cams were necessary with inter-connected relationships in order for the process to be automatic and versatile for adjustments to suit different grades of tobacco.

It will be remembered that Taylor Instrument Companies played a major role in the instrumentation design and supply for the Carbide Plant, the company being the prime contractor for the instrumentation portion of the plant. Mr. Reamer was Taylor's resident engineer here at Oak Ridge during the installation period, June 1943, to May 1944. He has been with Taylor for ten years as an application engineer.

The program committee announced that the plans for Dr. J. J. Grebe to speak on "Unusual Control Problems" at the February 4th meeting were complete. Dr. Grebe is considered an expert on automatic control problems. He is on leave from Dow Chemical Company as Physical Research Director, to attend the Training School being conducted by Monsanto Chemical Company at Clinton Laboratories here in Oak Ridge.

The March meeting will feature a joint discussion by Mr. L. E. Emerich and Mr. J. E. Schock of Leeds and Northrup Company on the development of Industrial Recorders through the Speedomax "G."

The April meeting will feature Mr. J. E. Michaelson of General Electric Company speaking on new measuring instruments.

The May meeting plans are indefinite.

The June meeting will feature Mr. Vernon D. Hauck of Friez Instrument Division—Bendix Aviation Corporation speaking on "Radiosonde: Present Status of the Art."

July meeting plans are indefinite.

The August meeting will feature a discussion of "Induction Heating" by a representative of the Westinghouse Electric Corporation.

—Chas. W. Covey, *Corr.*

PHILADELPHIA

The Philadelphia Section was especially privileged in holding its December 18th meeting in the magnificent lecture hall of the Franklin Institute.

Doc White briefly reviewed the proceedings of the National Board of Directors meeting held for December in New York City. The announcement that Philadelphia's invitation to the National Society for its 1948 Conference had been accepted was received with a very enthusiastic round of applause.

1947 President, George Ehly, of the Atlantic Refining Company, and Vice-President Edwin Kremer, of Pennsylvania Industrial Chemical Company, each made short addresses promising unabated effort toward making 1947 an interesting and successful year.

After the introduction of new members and the reading of annual reports, the speaker for the evening was introduced. Mr. Otto Vetter, President and Chief Engineer of the Ring Balance Instrument Company, spoke on the subject "Measurement of Flow Under Laminar and Turbulent Conditions."

In development of this subject Mr. Vetter analyzed the theory of fluid viscosity, and derived viscosity values from shearing stresses, in both absolute and gravitational units. He then described laminar flow as a low velocity flow usually occurring in small pipe sizes at extreme pressures. The line of demarcation between laminar and turbulent flow is usually considered to occur at a 2000 Reynolds number. The Reynolds number is therefore the only sensible yardstick available for classification of fluid flow.

Mr. Vetter then developed the derivation of the Reynolds number mathematically, using consistent units and proving that it becomes a pure number which is dimensionless. In the course of the dissertation it was pointed out that the geometrical shape of the velocity profile cannot be determined definitely, since it is affected by both fluid viscosity and the kinetic forces resulting from flow. In the case of laminar flow, friction drag may be omitted from consideration, due to the low velocity of the fluid film against the wall.

Wednesday, January 22, 1947—"Instrument Development Activities in a Chemical Company," by Mr. Victor F. Hanson, duPont Engineering Research Laboratory.

February meeting—Wednesday the 19th. Speaker and subject to be announced.

—J. H. BERTRAM, *Corr.*

PITTSBURGH

The December meeting of the Pittsburgh Section was held at the Carnegie Institute on Thursday, December 19th. Fifty-five members enjoyed a delicious dinner served in the Cafeteria, and then adjourned to the Lecture Hall for the meeting.

After a brief business meeting, during which four new members were welcomed to the fold, Mr. Charles A. Packard of Struthers-Dunn, Inc., gave a talk on "The Relay as an Instrument Auxiliary." He outlined the many classifications of relays in general use, exhibited slides showing a number of specialized circuits, mentioned some of the innate limitations of conventional relays which give the relay engineers premature gray hair, and concluded his address with a plea that equipment designers allow experienced relay engineers their choice of circuits in new equipment.

After the scheduled address, Mr. Packard surprised his audience by giving the first public demonstration of a new device which he calls a "motoroid." This is an adaptation of the old-fashioned constant current transformer and consists of a solenoid placed at one end of a bar of steel. A copper or aluminum ring encircles the bar and, when the solenoid is energized, the secondary current induced in the copper causes the ring to be repulsed by the solenoid. Several types of "motoroids" were demonstrated and practical applications for its use were suggested.

The next meeting will be held on January 27, 1947 at the Carnegie Institute. The subject, "Pressure Gages," will be presented by Mr. A. E. Levan, United States Gauge Division, American Machine and Metals Inc., Sellersville, Pennsylvania.

The February 24th meeting will feature Mr. R. J. Kryter of Esterline-Augus Company, who will present "The Endless Quest—The Application of Electrical Recording Instruments to the Solution of Problems of Industry and Technology."

—A. G. YOUNG, *Corr.*

SOUTHERN MICHIGAN

Fifty-five members and guests of the Southern Michigan Section enjoyed a delicious steak dinner, the night of Jan. 15th at Chicken Charlie's in Kalamazoo, Michigan.

Following the dinner a short business meeting was held. The annual treasurer's report was read and approved. The Secretary announced that three new applications for membership had been received and accepted.

Mr. Oliver Woods of the Upjohn Co., Kalamazoo, introduced Dr. Ralph A. Sawyer, dean of the Rackham Graduate school of the University of Michigan, who discussed "The Technical Aspects of the Bikini Test."

Dr. Sawyer listed the four major objectives of the test as:

1. To determine the effects on all types of naval vessels.
2. To determine the effects on all types of military and naval equipment.
3. To determine the effects on personnel.
4. To collect technical and scientific data.

There was not a single injury to the over 42,000 Army and Naval Technicians and 3,000 Air Force personnel as a result of the test.

It was necessary to check every detail of all the vessels used in the test, before the test so that all effects could be determined. This was a tremendous job.

About 300 pigs, 300 goats, and thousands of white rats were placed at different locations on the vessels. About one quarter of them died from exposure of the bombs. Much information was gained on the treatment of personnel exposed to radiation.

Tests were made to determine the blast pressure, the diffusion in the water and the waves formed, the distribution of radiation in the water and the effects of radiation on plant life and fish in the water.

There were several duplications of the many different types of measuring and recording instruments used in the tests, ranging from very simple mechanical devices such as five gallon oil cans to measure blast pressure, pieces of lead in balls of putty to measure stress and strains of different parts of the ships, photographic plates to measure gamma rays, to the latest thing in high precision measurement and recording instruments.

About 300 photographic cameras of all types were placed on board ship and a like number in planes and a large number on Bikini in order to photograph the test from as many different angles as possible. It was very necessary to get as much information as possible the first time because the test could not be repeated.

The test was highly successful and all objectives were reached.

Dr. Sawyer worked on the test with the Army scientific team. He believes that if the same talent, energy and effort with the same financial backing used in developing the Atomic Bomb were applied to the development of Atomic Energy as a source of peace time power it would be only a matter of a few years when that dream would become a reality.

Twenty minutes of 16 mm. film covering the test followed Dr. Sawyer's most interesting discourse on this most timely topic.

—KEN MEAD, *Corr.*

ST. LOUIS

Monday, December 30, 1946, featured a triple-header all-members program. The first speaker was W. G. (Bill) Lee, Instrument Engineer at National Lead Company, Titanium Division, who discussed "Thermocouple Wells in Chemical Applications." The second speaker was Carl L. Werstler, Instrument Engineer at Socony-Vacuum Oil Company Refinery, whose talk covered "Thermocouple Protection Tubes and Thermowells in Petroleum Refining." The third talk along the same lines was "Thermocouple Protection in the Glass Industry" by Roy Finch, Instrument Engineer at the Alton (Ill.) plant of Owens-Illinois Glass Company.

Next meeting—January 27, 1947. Speaker: Mr. M. J. Boho, Engineer, The Hagan Corporation. Subject: "Cascaded Controls and Their Application."

—HENRY ZEFFREN, *Sec'y.*

TENNESSEE

The 20th meeting of the Instrument Society of America, Tennessee Section, was held Wednesday, December 11, 1946, at the Tennessee Eastman Corporation.

The meeting was called to order at 8:00 P.M. by Mr. J. T. Elder, President. A brief financial report was presented by the treasurer and a suggestion for having the January meeting in Elizabethton, Tennessee, on January 8, 1947 was approved.

Mr. Ralph Rockwell, Director of Engineering of the Mason-Neilan Company, addressed the group on the subject "Liquid Level Controls & Control Valves." His talk was centered around typical applications and was enthusiastically received by the Section.

The 21st meeting of the Tennessee Section was held at the Franklin Club, Elizabethton, Tennessee, on January 8, 1947. Free dinners were served to all Society members from the funds of the local Section.

A membership drive for the coming year was discussed and a committee of five members elected to draw up plans. It was decided to circulate a questionnaire to the section members to obtain their desires the time, type and place of meetings f the coming year. A committee was al appointed to obtain data on meeting place Two visitors and one new member, M Glenn Thomas, were introduced to the se tion. Committees appointed were as follow

MEMBERSHIP DRIVE
Geo. Moorehouse—Chairman
R. E. Freeman
Joe Selby
L. O. Harrell
Robert Paris

MEETING PLACE
R. P. O'Neill—Chairman
J. W. Watkins
J. H. Rion

Mr. V. P. Head of the Fischer & Port Company addressed the group on t "Theory of the Rotameter." This theory w expanded to show special instruments f specific gravity and viscosity. A new speci viscosity meter to measure very hi viscosity was explained.

A discussion of his talk and question covering changes in rotameter capacity fo lowed the talk. The meeting was adjourne at 10:30 P.M.

—F. H. THEIL, *Sec*

WASHINGTON

The twenty seventh meeting of the Was ington Section was held at the Pepco Aud torium Monday, Dec. 16th at 8:00 P.M. Th results of the election of officers were a nounced. Dr. W. G. Brombacher, Nation Bureau of Standards, was elected Pres dent. The two Vice Presidents are O. Patton, Civil Aeronautics Administrati and W. A. Wildhack, National Bureau Standards. Our national Delegate is Ralp L. Goetzenberger, Minneapolis-Honeywe Regulator Co. R. G. Quick was re-electe recording secretary.

As is our custom, our retiring presiden R. C. Darnell, becomes a councilor.

The elective officers whose terms hav not expired are: G. M. Rolls, Correspond ing Secretary; Raymond Morgan, Trea urer; A. H. Mears, Councilor.

E. L. Deeter, Naval Ordnance Lab. wa appointed chairman of the Meetings com mittee with Richard Brown and John May as co-committeemen.. Mac. W. Grossman remains as chairman of th Membership Committee.

Annual reports of all the officers wer given.

After the business session the meetin was turned over to Mr. Edward J. Barlow Research Engineer, Sperry Gyroscope Co Inc. whose subject was "Klystron Tubes. Mr. Barlow gave a very interesting tal covering the Klystron tubes from origi through development and present-day us illustrated with slides and blackboard. A the conclusion of the talk the meeting wa opened to a lively discussion period durin which Mr. Barlow was able to satisfy a queries.

—G. M. ROLLS, *Cor*

WAYNE COUNTY

The Wayne County Section I.S.A. hel its regular monthly meeting on January at the Presbyterian Church House Wyandotte, Michigan. The dinner was hel at 6:30 and the meeting at 8:00.

President John MacPherson appointed nominating committee consisting of Iva Genaw, chairman, B. K. Beecher and Pa Dennis for the local election of officers be held in April.

Herb Barnum and Bill Baker reported the activities of the National Society.

The speaker of the evening was M E. F. Nordstrom, Engineer in charge Gage Manufacturing of Manning, Maxwe and Moore Company. Mr. Nordstrom gav a very interesting talk on glass and dia thermometers, pressure gages and sel operating temperature controllers.

The next meeting will be held on Feb ruary 17 at which time several movies Instrument Manufacture and Applicatio will be shown.

The March meeting will be held on Marc 17 at which time W. H. Kidd of the Fox boro Company will talk on "Control Valves."

—W. G. BAKER, *Cor*

I.S.A. SECTION DELEGATES, SECRETARIES and JOURNAL CORRESPONDENTS

(As of January 10, 1947)

SECTION	DELEGATE	SECRETARY	*JOURNAL* CORRESPONDENT
TIMORE	Franklyn Ragan, Bethlehem Steel Co., Fuel Division, Sparrows Point 19, Md.	H. L. Halstead, 45 Yorkway Rd., Baltimore 22, Md.	Kenneth R. Miller, 2729 Englewood Ave., Baltimore 14, Md.
IFORNIA	James A. Broadston, Surface Checking Gage Co., 1937 Taft Ave., Hollywood 28, Calif.	M. D. Pugh, 35 So. Raymond Ave., Pasadena 1, Calif.	Secretary
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AUTOMATIC CONTROL ENGINEER, graduate, with experience in automatic controls such as servomechanisms for experimental work covering automatic, hydraulic, and electrical controls and instrumentation used in process industries. Must have creative mind and ability to assimilate and follow through to completion any new assignments. Box 33.

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CHEMICAL ENGINEER with instrumentation experience. Personable, progressive young man to take over the direction of the instrument development and control department. This department represents a new addition to the organization of a large manufacturer of chemicals, pharmaceuticals, and biological products. Worthwhile opportunity for man with proper qualifications. Box 36.

Technical Society News

AKRON

The Akron Instrument Society met on January 28th, at the Akron YWCA. President Luther announced the closing of the contest for a Society emblem. About thirty designs were submitted. The winner will be announced at the February meeting.

The Nominating Committee submitted the following slate of candidates for the February elections: President, S. T. Wepsic (Firestone); Vice-President, Frances Weisend (Goodrich); Secretary, Fred Appel, Jr. (Pittsburgh Plate); Treasurer, Robert E. Vaughn (Firestone); Executive Board, Earl E. Larson (Goodrich) and Howard Levine (Goodyear). A call for nominations from the floor brought only one—Carl A. Antes (Goodyear) for the Executive Board. Two Executive Board members will be elected in February in the only contest.

Following the business meeting, President Luther introduced Mr. C. B. Moore, President of the Moore Products Co., of Philadelphia, whose subject was "Solution of Instrumentation Problems by the Pneumatic Null Balance Method." Mr. Moore's discussion was an extremely interesting and instructive one and was very well received by the members. After developing the theory of the Pneumatic Null Balance, he explained its application to various types of control problems. His explanation of the principles involved in proportional response, reset and rate response were very clear and of benefit to many of us.

The next meeting of the Society is set for February 25th, at the Firestone Country Club, a dinner at 6:30 P.M. preceding the meeting. Election for the Executive Board will take place.

—Fred Appel, Jr., *Secy.*

ATLANTA

[Rec'd too late for Jan. issue]

The regular December meeting of the Georgia Society for Measurement and Control was held at the auditorium of the Atlantic Steel Company.

Following a brief business meeting, M. Virgil Davis, Instrument Engineer for the Atlantic Steel Company, gave a very interesting discussion on the subject of Practical Pyrometry. Davis' discussion commenced with the early history and basic theory of high temperature measurements and covered thermocouple and radiation methods.

The regular January meeting will be held on January 27th. The speaker of the evening will be P. Barron, Foxboro Company. His subject will be the Foxboro Dynalog.

—R. E. Fishburn, *Publicity*

BOSTON

The Boston Instrument Society held its regular monthly meeting on Wednesday evening, January 22, 1947, at 6:30 P.M. at Thompson's Spa in Boston.

W. P. Wills, Director of Research and Development, Brown Instrument Co., spoke on "Electronics in Instrumentation." Prefacing his very interesting talk, Mr. Wills remarked that he had addressed many instrument societies throughout the country and that the attendance at the Boston Instrument Society was by far the largest that he had seen.

There were eighty-five present, some coming for at least fifty miles in zero temperature to attend the meeting.

The arrangements for the dinner and meeting were under the supervision of H. S. Fairchild, Pres., assisted by G. L. Seavey, C. J. Nazzaro and J. H. Condon.

The next meeting will be in February, the date and place to be announced later.

—J. H. Condon, *Cor. Secy.*

HARTFORD SOCIETY FOR MEASUREMENT AND CONTROL

The January meeting of the Hartford Society for Measurement and Control was held January 15 at the City Club, Hartford. The technical talk, on the subject of "Balancing Machines with Associated Correction Equipment," was given by F. R. Bokorney of the Gisholt Machine Mompany, Madison, Wis.

The next meeting will be Wednesday, February 19, at the City Club, 19 Allyn St., Hartford.

INDIANAPOLIS TECHNICAL INSTRUMENT SOCIETY

The January meeting of the Indianapolis Technical Instrument Society was held January 7, 1947 at the Indiana-War Memorial. At this meeting A. A. Hejduk of the Meriam Company gave a talk on "Manometers in Industry." Hejduk's talk covered the principles, development and application of the various types of manometers. He developed the methods for measuring pressures from thousanths of an inch to hundreds of inches of water and stressed the fact that a manometer is a primary standard.

On March 4, 1947 Charles A. Packard, Consulting Relay Engineer, will talk on "Relays and Instrumentation."

—Morris Underwood, *Secretary*

LOUISVILLE INSTRUMENT SOCIETY

The Louisville Instrument Society held its second meeting January 14, 1947. The following officers were elected for the year 1947: *President*, E. H. C. Brown; *Vice Pres.*, J. J. Monahon, Jr.; *Secretary*, S. W. Hawkinson; *Treasurer*, M. J. Johnson; *Directors*, T. P. Grose, L. Driskell and A. L. Weyhing.

The President appointed the following committees to act for the coming year: C
stitution and By-laws, Program, Enterta
ment and Membership.

—S. W. Hawkinson, *Secret*

SOUTHWEST LOUISIANA

A new society for instrument men a
technicians has been formed in La
Charles as the Instrument Society of Sou
west Louisiana. The group is composed
instrument technicians from several indu
trial plants in the Gulf area, interested
the furtherance of instrument education a
fellowship throughout the area.

The first meeting of the Society was h
December 3, 1946, at which time, offic
were elected and a constitution framed.
date, over fifty persons have joined the S
ciety, and an equal number has express
interest in the group's activities.

Officers of the organization are Char
Pratt, Mathieson Alkali Works, Presider
Dale Mattix, Cities Service Refinery, Vi
President; W. F. Walker, Southern Alk
Corp., Secretary; and Tom Clarke, Cit
Service Butadiene Plant, Treasurer. Ric
ard Groendycke, Cities Service Refinery,
Chairman of the program committee.

J. E. Barclay, of the Mathieson Alk
Works, addressed the group's meeting
January 21, with a talk entitled, "Hig
Vacuum Techniques." Mr. Barclay pr
sented a résumé of equipment and instr
ments used in obtaining and measuri
high-vacuums, and discussed analytical
struments utilizing high vacua.

The Society extends an invitation for
engineers and technicians in the area
write the Secretary if only to request t
date and topic of the next meeting.

W. F. Walker, *Secretary*,
Southern Alkali Corp.
P. O. Box 900, Lake Charles, L

MECHANICAL ENGINEERS' SPRING MEETING

TULSA, OKLA.—"The Industrial Dev
opment of the Southwest" has been a
nounced as the theme of the 1947 Spri
Meeting of The American Society of M
chanical Engineers, to be held March 2-5
the Mayo Hotel in Tulsa, Okla. Twenty-fi
technical papers or addresses will be giv
at 13 technical sessions, one of which w
be on industrial instruments and regulato

The technical program includes a pap
entitled "Description of an Instrument f
Determining the Physical Constants of P
troleum in the Field," by P. G. Exline, se
tion engineer with the Gulf Research a
Development Co., Pittsburgh, Penna. and
paper on a "Deep Well Camera" by Ormo
E. Barstow of the Dow Chemical Co., Mi
land, Mich., and C. M. Bryant of Dowe
Inc., Tulsa, Okla.

Dr. John J. Grebe will speak on "Futu

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Manufacturers' Representative with degree in engineering and six years' experience in application and sales of automatic control equipment and instruments for industry, research, and communications seeks a few progressive companies desiring technical sales representation in the Carolinas and Virginia. Box 126, Instruments Publishing Co., 1117 Wolfendale St., Pittsburgh 12, Pa.

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dustries of the Southwest." He is on loan the Clinton Laboratories of the Monsanto emical Co. at Oak Ridge, Tenn., from the w Chemical Co. of Midland, Mich.

AIEE MEETING FEATURES INSTRUMENTATION

Numerous technical papers on measure- ent and automatic-control subjects were esented during the Winter Technical Meet- g of the American Institute of Electrical gineers held in New York, January 27 31. The technical program comprising enty-six sessions and sixteen conferences as the largest in the history of the Insti- te. Copies of papers may be ordered by ail from the AIEE Order Dep't, 33 West th St., New York 18, N. Y., at prices indi- ted. (To members of the AIEE, prices are e-half those indicated.) In ordering, please ention the serial number. A partial list of e measurement and control papers fol- ws:

47-14. "An Integrated Control System for rcraft D-c Generators" by A. T. McClin- n, 30 cents.

47-51. "Automatic Control of Air Switch- for Line Sectionalizing and Load Trans- r" by F. W. Rich and M. S. Kirwen. 40 nts.

47-48. "A 60-cycle Hysteresis Loop Tracer r Small Samples of Low Permeability Ma- rial" by D. E. Wiegand and W. W. Han- n. 60 cents.

47-86. "Pulse Echo Measurements on elephone and Television Facilities" by L. Abraham, A. W. Lebert, J. B. Maggio d J. T. Schott. 40 cents.

47-94. "Accuracy of Temperature Mea- rement on Coil Surfaces" by H. M. Beede d B. M. Cain. 30 cents.

47-36. "The Multistage Rototrol" by M. Liwschitz. 40 cents.

47-64. "Functionalized Resistance Weld- g Control" by C. B. Stadum, W. E. Large d E. C. Hartwig. 30 cents.

47-84. "A Magnetic Compass With Cath- de-ray Sensing Element" by W. H. Kliever d R. R. Syrdal. 40 cents.

47-85. "Electronic Null Detectors for Use ith Impedance Bridges" by H. W. Lam- n. 30 cents.

47-19. "A Thrustor Lowering Control ystem for A-c. Crane Hoists" by E. L. chwarz-Kast. 40 cents.

47-47. "Radar Technique in an Industrial ontrol" by W. D. Cockrell. 30 cents.

47-48. "A Balanced Amplifier Using iased Saturable Core Reactors" by H. S. irschbaum and E. L. Harder. 50 cents.

47-22. "Advancements in the Design of ong-Scale Indicating Instruments" by R. Rowell and N. P. Millar. 40 cents.

47-23. "Measurement of High Q Cavi- es at 10,000 Megacycles" by R. W. Lange. 0 cents.

47-24. "A Polyphase Thermal Ampere emand Meter" by A. J. Petzinger. 40 cents.

47-38. "Braking Resistors and Control r Diesel-Electric Locomotives" by E. F. eiser. 30 cents.

47-39. "A Power Plant Regulating Sys- em for Diesel-Electric Locomotives" by . B. Lewis. 30 cents.

47-40. "Developments in Control Systems r Diesel-Electric Locomotives" by M. D. enshaw. 40 cents.

47-27. "Automatically Controlled Copper- xide Rectifiers for Electroplating and An- dizing Applications" by J. J. Buckley. 30 nts.

47-56. "Testing Governor Performance on lectric Power Systems With Improved In- truments" by J. E. Allen and W. B. Hess. 0 cents.

47-57. "Automatic Control of Hydroelec- ric Generating Stations" by M. J. Brown d W. A. Derr. 60 cents.

47-65. "Grounding of Instrument Trans- ormer Secondary Circuits" AIEE Com- ittee Report. 30 cents.

47-15. "Dimensionless Analysis of Servo- echanisms by Electrical Analogy" by G. D. cCann and S. W. Herwald. 50 cents.

47-52. "Laboratory Aids for Electrome- hanical System Development" by G. C. ewton, Jr. and W. T. White. 30 cents.

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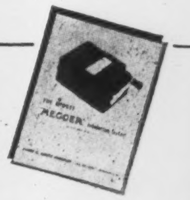

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Manufacturers' New Literature

In this department we report new literature pertaining to Instrumentation, received from th manufacturers. We urge readers to request ONLY those bulletins which will be of value t them. Use the Postage-free Order Card on page 191.

O-48 **Laboratory Stirrer.** 2-page 8½" × 11" folder pictures and describes the "Eberbach Air Stirrer" which can be operated by either air pressure or vacuum with speeds regulated by the air valve. Eberbach & Son Co., Ann Arbor, Mich.

O-49 **Thermal Relay.** 8-page 8½" × 11" Publication No. 3007X pictures and describes the "Model 510 Thermal Relay," obtainable with any specified time delay. Thomas A. Edison, Inc., Instrument Div., West Orange, N. J.

O-50 **Audio-frequency Generator.** 4-page 8½" × 11" Bulletin No. 35 pictures and describes the "Model MR-1000" audio-frequency generator with output of 35 milliwatts at 1000 cps. Televiso Products Co., 7466 W. Irving Park Rd., Chicago 34, Ill.

O-51 **Comparison and Limit Bridge.** 4-page 8½" × 11" bulletin pictures and describes the "Freed No. 1010" comparison and limit bridge for testing resistors, capacitors and inductors. Freed Transformer Co., Inc., Instruments Div., 72 Spring St., New York 12, N. Y.

O-52 **Electric Control Devices.** 8-page 8½" × 11" Bulletin 100,000 pictures and describes this maker's line of electric control devices, including a-c. and d-c. motor starters, speed and voltage regulators, resistors, ring and plate rheostats, switches, magnetic contactors, relays and dimmers. Ward Leonard Electric Co., Mount Vernon, N. Y.

O-53 **Micrometers.** 8-page 8½" × 11" bulletin pictures and describes the "Swedish" micrometer with hardened and ground lead screw. Swedish Gage Co. of America, 8900 Alpine Ave., Detroit 4, Mich.

O-54 **Optical Flats.** 2-page 8½" × 11" Bulletin 453 lists maker's line of optical flats, single or double surface, in glass or quartz. Acme Scientific Co., 200-214 N. Laflin St., Chicago 7, Ill.

O-55 **Solenoids and Rectifiers.** 34-page 8½" × 11" bulletin pictures and describes "Ledex" rotary solenoids and rectifiers. Includes engineering data, drawings and power graphs. George H. Leland, Inc 113 Webster St., Dayton 2, Ohio.

O-56 **Laboratory Instruments.** 96-pag 8½" × 11" supplementary catalog pictures and describes post-war addition and improvements to maker's line of laboratory instruments. W. M. Welch Mfg Co., 1515 Sedgwick St., Chicago 10, Ill.

O-57 **Dial-indicating Thermometers.** 4-page 8½" × 11" Bulletin 500 pictures an describes "Trerice" dial-indicating thermometers in 4½" and 6" sizes with variety of accessories. H. O. Trerice Co 1420 W. Lafayette Blvd., Detroit 16, Mich

O-58 **Testing Instruments.** 4-page 8½ × 11" bulletin with several inserts pictures and describes Brinell testing machines, universal testing machines, impact testers, and ductility testing machines. Steel City Testing Laboratory 8843 Livernois Ave., Detroit 4, Mich.

O-59 **Fatigue Testing Machine.** 4-pag 8½" × 11" Bulletin 205 pictures and describes the "Sonntag Model SF-10R" rotating-beam fatigue testing machin which produces a constant bending moment from 0 to 10,000 in.-lbs. on roun specimens as large as 1" diam. Baldwi Locomotive Works, Philadelphia 42, Pa

O-60 **Polishing Cloths and Abrasive** 4-page 8½" × 11" Bulletin 202 describe "Burrell" polishing cloths and abrasive for preparing metallurgical specimens Swatches of cloths are included. Burrel Technical Supply Co., 1936 5th Ave., Pittsburgh 19, Pa.

O-61 **Noise Suppressor.** 8-page 6" × 9 Bulletin 910 pictures and describes "Typ 910-A" dynamic noise suppressor for th reduction of record scratch and rumbl in broadcasting. Technology Instrumen Corp., 1058 Main St., Waltham 54, Mass.

O-62 **Phase Microscopy.** 36-page 6" × 9" booklet is a reprint of an article by A. H. Bennett, Helen Jupnik, Harold Osterberg and Oscar W. Richards from *Transactions of the American Microscopica Society,* Vol. 65, April 1946. America Optical Co., Scientific Instrument Div. Buffalo 15, N. Y.

MONTGOMERY TUBES

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-63 **Remote Indication and Control tems.** 12-page 8½" × 11" Bulletin 6641 pictures and describes d-c. 2-se sinusoidal remote indication and trol systems for a variety of remote-trol, remote-indicating and remote-aling applications. Allis-Chalmers Co., 686, Milwaukee 1, Wis.

-64 **Voltage Controllers.** 12-page 8½" 1" Bulletin 150 is a catalog of maker's plete line of variable voltage trans-mers, automatic voltage regulators test instruments. Includes charts of ings, circuit diagrams and dimensional wings. Superior Electric Co., 713 rel St., Bristol, Conn.

0-65 **Thermowells.** 4-page 8½" × 11" lletin pictures and describes maker's e of standard test wells. Trinity Equipment and Supply Co., 605 Broad St., New-, N. J.

0-66 **Miniature Switch.** 4-page 8½" × Data Sheet 38 pictures and describes ZE-2RQ4" switch for manual safety trol for air presses, punch presses and raulic presses, and for other control lications. Micro Switch, Div. of First ustrial Corp., Freeport, Ill.

0-67 **"General Radio Experimenter."** page 6" × 9" Vol. 22 No. 4 of this se organ is devoted to articles on the pe 726-A Vacuum-tube Voltmeter" the "Type 707-A Cathode-ray Null tector." General Radio Co., 275 Mas-husetts Ave., Cambridge 39, Mass.

0-68 **Transformers.** 12-page 8½" × catalog pictures and describes mak-s line of transformers including power nsformers, filter chokes and vibrator nsformers, audio reactors, output nsformers, etc. Freed Transformer , 72 Spring St., New York 12, N. Y.

0-69 **Ultrasonics.** 8-page 8½" × 11" lletin No. 36 tells something about the ence of high-frequency sound waves, luding a history of its development a bibliography of 16 references. Pic-es and describes the application of odel U-300 and U-500 Ultrasons." Tele-o Products Co., 466 W. Irving Park , Chicago 34, Ill.

0-70 **Temperature Controllers.** 8-page " × 11" bulletin pictures and de-ibes maker's line of temperature con-llers for use on ovens, tanks, etc., rling Instrument Co., 253 Springfield e., Newark 3, N. J.

0-71 **Stopwatches,** 6-page 8½" × 11" der pictures and describes both wrist pocket stopwatches in a number of pes. Meylan Stopwatch Corp., 264 W. h St., New York 18, N. Y.

0-72 **Dilatometer.** 6-page 8½" × 11" lletin W1803 with inserted charts pic-es and describes the "Model A-134 istol-Rockwell Dilatometer" which cords temperature-time and tempera-re-dilation changes. The Bristol Co., aterbury 91, Conn.

0-73 **Electronic Laboratory Instru-nts.** 32-page 8½" × 11" Catalog No. A pictures and describes the "hp" line electronic laboratory instruments in-ding audio oscillators, audio signal nerators, low frequency standards, dis-tion analyzers, vacuum-tube volt-ters, etc. Hewlett-Packard Co., 395 ge Mill Rd., Palo Alto, Calif.

0-74 **Reflectometer.** 4-page 6" × 9" lletin pictures and describes the unter Multipurpose Reflectometer", a ll-type instrument used for reflec-nce, color, gloss and transmission mea-rements. Henry A. Gardner Labora-y, Inc., Apparatus Div., 4723 Elm St., thesda, Md.

0-75 **Ring Spherometer.** 4-page 8½" × " bulletin pictures and describes the 404 Ring Spherometer" for measuring e radius of curvature of concave and nvex spherical surfaces. Gaertner

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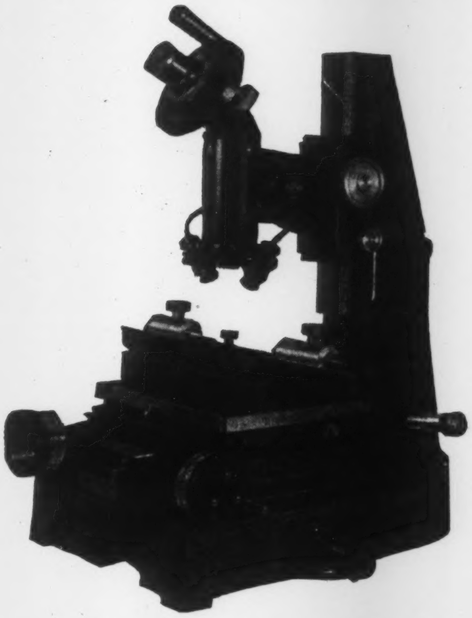

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